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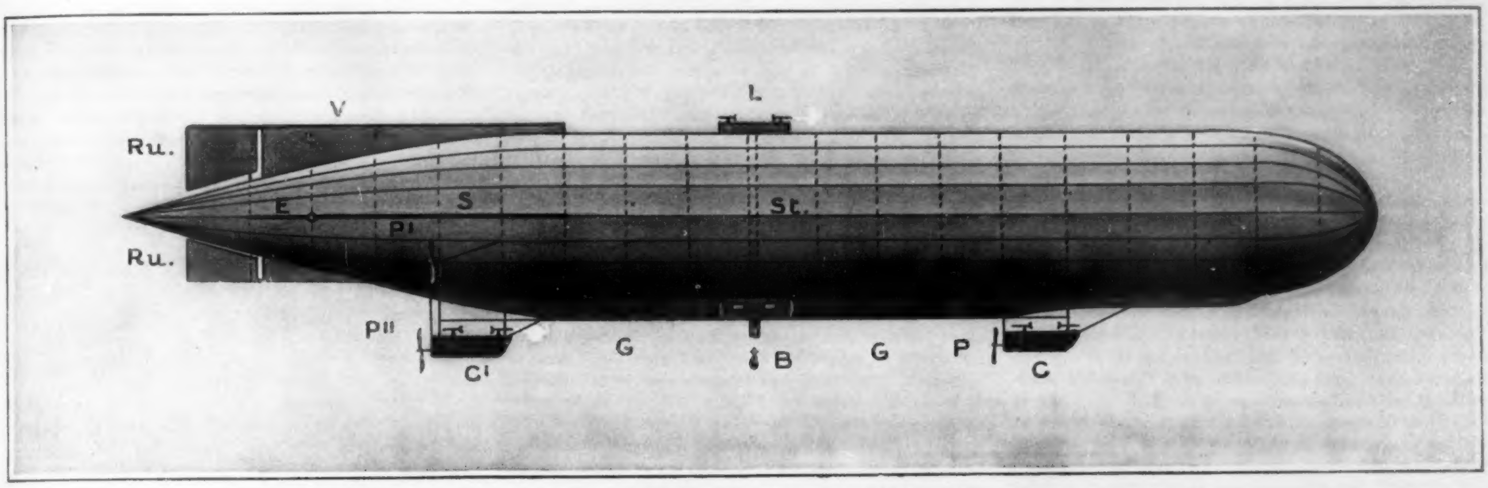

Outline (side-view) of a 30-ton super-Zeppelin. Drawn to data obtained from the wrecks of LZ-77 and L-15

(C C') engine cars (the one in front containing the pilot house); (P.P.'P.") propellers; (G) gangway connecting the cars and containing water-ballast and fuel tanks; (St) stairway leading from bomb-room (B) to armed lookout (L); (S) stabilizing fin; (E) elevator; (V) vertical fin; (Ru) rudders.

Super-Zeppelins

By Baron Ladislas d'Orcy, Member, American Institute of Aeronautic Engineers

IT is common knowledge that for some time past a new type of Zeppelin, far more powerful than any of its predecessors, has been commissioned with the Air Service of the German Navy. The recent destruction, by the agency of the Allies' anti-aircraft artillery, of two of these vessels has now afforded the long-sought opportunity for getting a closer view of this type of aircraft, which for the sake of convenience we shall term a super-Zeppelin.

A layman might hardly discern any change in the outward appearance of a super-Zeppelin when compared with previous types; it appears, however, upon examination of what remained of the vessels destroyed at Révigny (the LZ-77) and in the mouth of the Thames (the L-15), that the hull, steering organs and propelling apparatus have been re-designed to a great extent on the latest types.

It is a matter of discussion whether there exists but one new type or whether the Zeppelin Works still turn out a large, long-range type for naval raids and one, smaller but faster, for military reconnaissances. The fact remains, however, that the Germans possess at present a large type of Zeppelin whose features, as far as they are known, shall be discussed herewith.

THE HULL.—The hull of the *ante-bellum* Zeppelins was in the shape of a cylinder with two symmetric ogival ends—a very poor form, aerodynamically speaking; and it was still made worse by an exaggerated aspect ratio of ten to one, which comes to say that the hull was ten diameters long.

On the super-Zeppelin this defect has been remedied to some extent. The bow is slightly blunter than before, while the stern is nearly conical; furthermore, the aspect ratio has been somewhat decreased, so that now the hull is only about eight or nine diameters long. Although this ratio is still some way off the one disclosed by aerodynamic research work to effect the smoothest air-flow (6:1), it must materially assist the super-Zeppelin in attaining a greater speed without the expenditure of additional power.

Regarding the size of super-Zeppelins, an examination of the wreck of the LZ-77 reveals that this vessel (which undoubtedly belonged to a recent type, as is disclosed by her factory number) was about 540 feet long, with a displacement of over 1,100,000 cubic feet which would furnish a lift of about 33 tons.

THE STEERING ORGANS.—The steering organs have been greatly simplified on the super-Zeppelin.

A picture of the L-15 (which was photographed before she broke up and sank) shows clearly that in place of a large number of small and parallel rudders and elevators, there is now a compact *empennage*, very similar to that of a tractor aeroplane. Both rudder and elevator now consist of simple "flaps" which are hinged to the vertical and horizontal fins, respectively.

Table Showing Probable Zeppelin Losses from August 1st, 1914 to May 3rd, 1916

No.	NAME.	PLACE.	DATE.	CAUSE OF LOSS.
1	Z-8*	Badonvillers, France	22- 8-1914	Destroyed by French gunners. Part of crew lost.
2	Z-5*	Mlava, Russia	29- 8-1914	Destroyed by Russian gunners. Crew lost.
3	?*	Seradz, Russia	6- 9-1914	Captured, while at anchor, by a cavalry patrol. Crew of 30, prisoners.
4	?	Düsseldorf, Germany	9-10-1914	Destroyed in shed by British aviators.
5	LZ-31*	Friedrichshafen, Germany	21-11-1914	Destroyed in shed by British aviators.
6	?	North Sea	23- 1-1915	Foundered during a storm.
7	L-3*	Esbjerg, Denmark	17- 2-1915	Stranded, having run out of fuel, and broke up. Crew of 16 interned.
8	L-9*	Boulogne, France	5- 3-1915	Foundered during a storm, after having raided Calais. Crew lost.
9	L-8*	Tirlemont, Belgium	4- 3-1915	Damaged by British aviator; wrecked on landing. 21 of crew killed.
10	?	Thielt, Belgium	12- 4-1915	Damaged, over Béthune, by French gunners; wrecked on landing.
11	?*	North Sea	26- 5-1915	Broke away without crew; foundered off Heligoland.
12	LZ-37*	Evere, Belgium	7- 6-1915	Destroyed in shed by British aviators.
13	LZ-38*	Ghent, Belgium	7- 6-1915	Destroyed in mid-air by British aviator; crew lost.
14	L-?*	Ostend, Belgium	10- 8-1915	Raided London. Destroyed, upon her return, by British aviators.
15	?*	Vilna, Russia	24- 8-1915	Shot down by Russian gunners; crew of 10 made prisoners.
16	?*	Saint-Hubert, Belgium	13-10-1915	Destroyed by exploding in mid-air.
17	?	Maubeuge, France	16-10-1915	Stranded on a chimney and broke up.
18	?	Grodno, Russia	5-11-1915	Destroyed by the storm on landing.
19	L-18*	Tondern, Germany	17-11-1915	Wrecked in shed through an accidental (?) explosion.
20	Z-28	Hamburg, Germany	17-11-1915	Wrecked by the storm.
21	L-22*	Tondern, Germany	1-12-1916	Destroyed in shed through accidental explosion of a bomb.
22	?*	Kalkun, Russia	5-12-1916	Shot down by Russian gunners. Crew lost.
23	?*	Mainvault, Belgium	30- 1-1916	Raided Paris. Damaged by French aviator; wrecked on landing.
24	L-19*	North Sea	21- 2-1916	Raided England. Probably run out of fuel; foundered. Crew lost.
25	LZ-77*	Révigny, France	21- 2-1916	Shot down by French motor guns; destroyed in fall. Crew of 15 killed.
26	L-15*	Kentish Knock, England	1- 4-1916	Shot down by British gunners; crew of 18 surrendered. Vessel sank.
27	L-20*	Stavanger, Norway	3- 5-1916	Raided Scotland. Stranded, having run out of fuel and drifted with the wind. Blown up by crew: 3 killed, 16 interned

* Destruction authenticated.

Their surface area has naturally increased, as the conical stern takes up less space than when it was blunt; as a consequence and, owing also to a smoother air-flow, the efficiency of the steering organs should have materially increased.

THE PROPELLING APPARATUS.—The distribution of power has been very radically re-designed on the super-Zeppelin, the new system being one that follows marine practice closer than was customary hitherto.

While the 1914-15 type of naval Zeppelin was propelled by two sets of two 200-horse-power engines, each set driving two air-screws mounted on outriggers on either side of the hull, the super-Zeppelin carries but one engine in the front car and three engines in the rear car. Two of the stern engines drive side propellers in the old fashion; but the third one, as well as the front engine, each drive a directly coupled propeller at the rear of the cars.

The advantages derived from mounting the propellers astern are manifold: Firstly, as there is nothing to interfere with the air thrown back by the propellers, the efficiency of the latter should be somewhat increased; secondly, the danger of sparks from the exhaust, which might ignite the hydrogen, is rendered very remote; and thirdly, the mounting of the engines in the stern car should afford more room in the front car for the navigating *personnel*.

One might therefore assume that ultimately the stern car will become the sole engine room, while the bow car will be the navigating room and nothing else. If this has not yet been done, it should rather be attributed to a lack of higher powered engines than to some obscure reason for keeping one propeller ahead.

ARMAMENT.—The armament of these vessels has hardly changed. The bomb-room has remained in the middle of the gangway, but the crude way of dropping bombs by hand has been superseded by a scientific appliance, whereby the bombs are released electrically.

In addition to the two machine guns mounted on each car, two more have been provided for arming the lookout post, atop of the hull, which is connected with the bomb-room by means of a stairway encased in a chimney.

* * * * * * *

Thus far the apparent changes affecting super-Zeppelins.

Modifications relative to the ratio of dead weight to useful load are more or less a matter of speculation. On the *ante-bellum* Zeppelins the useful load amounted to about one fourth of the total lift. According to a statement emanating from Count Zeppelin's secretary, the climbing power of the new type is two fifths better than on previous types and the load of ammunition amounts to two tons; it might therefore be assumed that the useful load is also at least two fifths better than heretofore, in which case its ratio would be 35 per cent of the total lift.

Such an improvement is entirely within the present-day possibilities, if one bears in mind that the ratio of dead weight to useful load *decreases* with the Zeppelin's size and that the super-Zeppelins displace about

(*Concluded on page 514*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

An Inverted Pyramid

BECAUSE of our geographical position, it may be said that the international policies of the United States are founded necessarily upon our navy, and that our policies and our navy are builded—or should be builded—as one structure, pyramidal in form, with the navy as the broad and unassailable foundation. We have constructed the pyramid,—there can be no doubt about that,—but we have inverted it, so that, to-day, we have an accumulation of far-reaching international policies imposed upon a navy all too small to take care of them. The joint structure has grown at the top and shrunk at the base, so that to-day it is in unstable equilibrium.

A distinguished officer of our navy writing, not long since, on the subject of the policies of nations, had this to say: "Modern science has made the nations of the earth neighbors and modern thought has tempered their intercourse. But national ambitions take life and grow as the nations prosper, and, being like those of the individual essentially selfish, the ambitions of one nation often excite the rivalry and opposition of another. So are born the policies of various people. When declared, these policies are but the formulated principles of conduct which the people of a state, or their government, have adopted in the pursuit of their national well being. When the policies of a state reach beyond its borders, they become of special interest to other states; for in these policies may be found the seeds of disagreement, perhaps of ultimate war."

During the first century of our existence as an independent state, we were so much concerned with our domestic affairs that we took but a languid interest in great-world policies, and (always excepting the Monroe Doctrine) we had no definitely-enunciated foreign policies which were likely to lead us into conflict with other states. The loss of the battleship "Maine" and our subsequent pacification of Cuba, however, brought about our long-deferred but inevitable graduation into the first rank of the world powers. It was only a few among us who realized what that purely humanitarian effort might lead to. As a matter of fact, the firing of the first gun of the war shook the country roughly out of its century-long international isolation and carried us so far beyond our borders, that, at the conclusion of the war, our frontier had been moved a thousand miles eastward into the Atlantic and five thousand miles westward across the Pacific, even to the very gates of Asia.

The significance of the Spanish War, however, lay not so much in its naval and military successes, as in its appeal to the dormant internationalism (if we may use the term) of the great republic of the New World. Among the lessons taught by the war, and fully appreciated by the people and its Congress, was the supreme importance of sea power. When Dewey crumpled up the Spanish fleet at Manila and Sampson and Schley strewed the southern coast of Cuba with the burning wreckage of Cevera's squadron, the decisive influence of sea power, always recognized by the naval expert, became self-evident, even to the man on the street. Congress lent a willing ear to its naval advisers and systematically and most liberally built up a navy that should be equal to the heavy responsibilities entailed by our newly-acquired and widely-separated possessions. Within half-a-dozen years of the conclusion of peace our navy had risen to the position of second in strength, with a commanding lead over that of Germany.

But, as it so turned out, in the very year, 1905, which found our navy in a position of such importance, the advent of the dreadnought relegated all existing battleships to the second line, and the leading naval powers began to reconstruct their navies along dreadnought lines, increasing their annual appropriations greatly in order to meet the crisis which had arisen. Our own Congress, unfortunately, so far from increasing appropriations, decreased them; and for the past eleven years we have so greatly neglected our navy that it has sunk to the third position in ships and to the fourth position in the number of officers and men. From the Spanish war to the advent of the dreadnought, Congress appropriated for the construction of new armored vessels at the average rate of four ships per year; but during the eleven years covering the dreadnought era Congress has authorized the construction of armored ships at the low average rate of only one and one half vessels per year.

We see, then, that so far as the navy, upon which the United States must primarily depend for the support and enforcement of its international policies is concerned, we have been steadily losing ground relatively to the other great powers. This is bad enough in itself; but it appears infinitely worse when we realize that during this period of relative decline of our navy among the great navies of the world, we have been emphasizing, adding to and enlarging our international policies on a scale and at a rate which is surely without parallel in the history of the world. Thus, we have reaffirmed the Monroe Doctrine by definite congressional action, in which we forbid the acquisition by any foreign power of a port or harbor which might be used as a naval base for operations directed against the Panama Canal. We have built the Panama Canal, thereby turning topsyturvy the long-established equilibrium of the world's seagoing commerce. We have proclaimed the neutrality of the canal, and we have shown our determination to uphold that neutrality by constructing first-class fortifications at each approach. We have taken our stand in support of the "open door" in China as opposed to the principle of separate spheres of influence, formerly advocated (and quite possibly to be advocated again) by the European powers. And, finally, we have offended the most refined and successful of the Oriental races by telling them that we do not want and will not have its people in any numbers in our midst. Moreover, at the present hour we are demanding of the second greatest naval power in the world that it shall practically abandon the use of the only element of its naval equipment with which, in its hour of dire extremity, it is able to strike back at a victorious enemy.

We have said enough, surely, to bring home the conviction that the naval-political situation in the United States is one which should cause the deepest concern and call for immediate and drastic readjustment. Indeed we can conceive of no duty among the many laid upon the present Congress that compares in urgency and in the high authority of its demand with that of restoring our navy with all possible dispatch to the position of second in strength which it occupied a decade ago. Here is a question which should be lifted out of the mire of politics and placed upon a high plane of the purest patriotism.

Our National Advisory Committee for Aeronautics

AN account of the new United States National Advisory Committee for Aeronautics was published in our issue of February 5th, 1916, page 140. The first annual report of this committee has now appeared, and deserves notice as a substantial proof of the fact that this country is taking its place with Germany, France and Great Britain as a leading contributor to the scientific side of an art the practical side of which was already so largely a product of American ingenuity.

The greater part of the bulky document in question is made up of a series of reports on particular topics, emanating from both official and unofficial sources. It is especially noteworthy, as a proof of the rising importance of industrial research, that three of these reports are contributed by manufacturing concerns. One on aviation wires and cables, their fastenings and connections, comes from the John A. Roebling's Sons Co., Trenton, N. J.; one on the relative worth of improvements on fabrics from the Goodyear Tire and Rubber Co.; and one on balloon and aeroplane fabrics from the United States Rubber Co. The Massachusetts Institute of Technology furnishes a report, by Messrs. Hunsaker and Wilson, on the behavior of aeroplanes in gusts. Messrs. Herschel and Buckingham, of the U. S. Bureau of Standards, contribute reports on the investigation of Pitot and Venturi tubes and other forms of anemometer. A preliminary report on the meteorological relations of aeronautics is given by Prof. Marvin, Chief of the Weather Bureau. Finally there is a voluminous memoir by Prof. Charles E. Lucke, of Columbia University, entitled "Thermodynamic Efficiency of Present Types of Internal Combustion Engines for Aircraft."

The administrative portion of the report contains a very well-considered summary of the work that lies before the committee, and makes a modest plea to Congress for enlarged facilities, including permanent headquarters in Washington and a staff of investigators and assistants able to devote continuous attention to the activities which the commttee is supposed to direct. Some of the problems that urgently demand solution are the development of the mathematical theory of stability, the improvement of air-speed meters, the evolution of more efficient wing sections for aeroplanes, the development of high-powered motors of light construction, improvements in the form of aeroplanes, the perfection of radio-telegraphic apparatus for aeroplanes, and the solution of a long series of detailed physical problems, relating to the various materials and methods of construction.

As illustrating the wide range of useful work cut out for the committee, it may be mentioned that this body proposes to collect statistics of aeronautical accidents in this country, and to make efforts to standardize legislation intended to guard against such accidents. The report states that "already a number of attempts have been made toward legislation in different states, with the result that in one state, at least, experimental work is practically prohibited, not because inventors and constructors cannot comply with the law, but because the operation of the law requires facilities which do not exist in the states in which the laws have been passed."

One important fact brought out by this report is that although the United States possesses many excellent potential agencies for carrying on aeronautical research, these have heretofore been utilized to a very limited extent for the purpose. Many of our educational institutions have mechanical laboratories and engineering courses capable of application to aeronautics, but only the Massachusetts Institute of Technology and the University of Michigan so far offer a regular course of instruction and experimentation. The statement is made that "in general, it appears that the interest of colleges is more one of curiosity than that of considering the problem as a true engineering one, requiring development of engineering resources, and, therefore, as not yet of sufficient importance to engage their serious attention," while "manufacturers are principally interested in the development of types which will meet Government requirements or popular demand, but which will not involve too radical or sudden changes from their assumed standard types."

We believe that the greatest need of aeronautics in this country has been just such a body as the new Advisory Committee, to serve as a clearing house of ideas as well as an active agency in directing and coördinating the work of American students and inventors. The Government cannot afford to refuse liberal support to the organization which it has—with somewhat belated wisdom—created.

Necessity of a Comprehensive Exploration of the Pacific

THE outstanding feature of the recent meeting of the National Academy of Sciences, in Washington, was the symposium on Prof. W. M. Davis's project of a comprehensive exploration of the Pacific, with addresses by a dozen representatives of the various sciences that would be benefited by such an undertaking. The project is still indefinite, and its realization, which would cost a great deal of money, is probably remote.

Prof. Davis declares that many problems of the Pacific are not susceptible of solution by independent and short-lived explorations, and that "future work should be broadly areal, rather than local, as on single islands, or linear, as in single voyages." He points to the magnetic work of the "Carnegie," with its repeated traverses of the ocean over many interwoven routes, as an example of the desired type of exploration, and suggests that the proposed work should be continuous through ten or twenty years. Thus the enterprise which he wishes the National Academy to father is not another "Challenger" expedition, but something far more ambitious and thorough.

The papers presented by the various specialists laid stress on the very fragmentary nature of the information we now possess concerning the largest of the oceans. For example, Mr. Littlehales declared that "in the North Pacific there is a tract twice as large as the United States which has been crossed by only a single line of sounding, at intervals about 250 miles wide, and a number of instances exist in which tracts as large as the United States remain entirely unfathomed." The biology, geology and meteorology of this huge ocean are in an equally neglected state, while the anthropology of the Pacific islands bristles with a number of unsolved problems.

The conference in question was, in fact, devoted chiefly to taking stock of our present knowledge of the Pacific—or rather lack of knowledge. It is somewhat discouraging to learn that the scores of famous expeditions that have scoured this ocean—from the days of the Spanish and Portuguese adventurers to the glorious age of Cook and La Pérouse, and onward, through the busy nineteenth century, to the present time—have accomplished relatively little.

Naval and Military Notes

A Fatal Compromise.—It is announced that the conferees on the army bill have compromised on a peace-strength for the army of 180,000 men. The House asked for 140,000 men; the Senate for 250,000 men, which latter the General Staff considered to be an irreducible minimum. The announcement that the 180,000 will be made convertible to a war-strength of 250,000 is a subterfuge. What the country needs is 250,000 regulars, fully trained and immediately available, should the thunderbolt of war strike without warning.

Looking Forward.—During the hearings on the Army Appropriation bill, Brig. Gen. Henry D. Sharpe, Q. M. Corps, recommended the purchase of $4,500,000 worth of cloth annually for four years, at the end of which time there would be on hand a reserve amounting to $17,000,000. This would furnish the uniforms and tents for 800,000 men. The tents and uniforms, should war come, would be manufactured before the men could be enlisted and mobilized. The manufacturers of uniforms, etc., would be supplied with patterns and specifications, and the clothing for a million men could be turned out in a few weeks.

The Threat of Militarism.—When the naval and military forces of a country take on a political character and are capable of exerting a strong political influence, that country is confronted with a sinister threat of militarism. It is the realization of this underlying principle that accounts for the growing hostility to the proposed mercenary federalization of the militia, as contained in the provisions of the Chamberlain and Hay bills. Under these bills a National Guard second lieutenant would receive $500 for seventy-two hours' work, and the pay to a private of the National Guard for seventy-two hours' work a year would be equal to one-quarter the wage of a regular army private for the entire year.

Loss of the Predreadnought "Russell."—In the sinking of the British predreadnought "Russell" by a mine in the Mediterranean the British Navy has lost its tenth capital ship since the war began. The others were the predreadnoughts "Irresistible," "Ocean," "King Edward VII," "Goliath," "Triumph," "Majestic," "Bulwark," and "Formidable." To these must be added the dreadnought "Audacious." The "Russell" was a small ship of 14,000 tons, designed in 1898, and she was therefore within a couple of years of the age limit. She mounted four 40-calibre 12-inch guns and twelve 6-inch guns.

Our Lack of Scouts.—"The mightiest battleship, unattended by numerous swift satellites is a blind behemoth, and a squadron of battleships without its proper complement of auxiliary craft, is constantly exposed to sudden disaster. This was a self-evident truth long before the present war, yet it would seem to have been ignored by the American naval administration until very recently." Thus says the "Naval and Military Record," and the statement is correct, for out of our thirty-two cruisers three only are able to steam at 23 to 23½ knots. We must lift our speed everywhere, for foreign navies have 25-knot battleships, 35- to 37-knot destroyers, 30-knot scouts and 18- to 20-knot submarines.

The Growth and Work of the British Navy.—Since the outbreak of the war the British Navy has shown a marvelous increase in ships and men. About 1,100,000 tons have been added in ships and the regular enlisted force has been doubled. Not only has the mighty German fleet been shut up in the Baltic, but in practically every quarter of the globe the British fleet has been transporting troops and munitions of war and keeping open the trade routes of the world. The task in the Mediterranean alone has been a most serious one, as witness the statement of the First Lord of the Admiralty that 1,000,000 combatants, 1,000,000 horses, 2,500,000 tons of stores and 27,000,000 gallons of oil have been transported to the Mediterranean for the use of the British and their allies.

Increase in Battleship Size.—Not only is the United States building battleships of great displacement, as witness our "Pennsylvania" of 31,400 tons, but the other nations, with the exception of Great Britain, are keeping well abreast of us in this respect. Thus, the Russian Navy is completing this year four battle-cruisers of 32,200 tons. Japan has in commission her 30,600-ton battleship "Fuso," and she is building three others, due to go into commission this year and next, of 31,300 tons. Italy will complete next year four battleships of 30,000 tons displacement, and Germany, it is believed, has completed since the war began three ships of close to 30,000 tons. The Japanese ships are to have a speed of 22.5 knots; the German, 23 knots; the Italian battleships, 25 knots, and the Russian battle-cruisers, 25½ knots.

Astronomy

A Harmless Zeppelin.—The striking spectacle presented by Venus and Jupiter in close proximity to each other in the evening sky on February 13th and 14th led to needless perturbation in many parts of France, where the two planets were mistaken by the unastronomical majority for the lights of a Zeppelin. At Rouen the alarm was complete; the approach of the hostile craft was announced by the firing of a cannon, the fire department turned out, and the people were not reassured until the planets had sunk peacefully below the horizon.

A Rapidly Moving Faint Star.—Comparison of two photographic plates of the region around Alpha Centauri, taken at an interval of 5.3 years, has, thanks to the blink-microscope, resulted in the discovery of a faint star having the remarkable proper motion of about five seconds annually. Only five other stars are known to have proper motions exceeding this value, and they are all much brighter than the star in question, the photographic magnitude of which is 12.0 on the Harvard scale. This discovery was made by Mr. R. T. A. Innes, of the Union Observatory, South Africa.

Finding Your Way by the Stars.—The need of soldiers, when marching or scouting at night, for a ready means of keeping their bearings is designed to be met in a little book recently published in England by R. Weatherhead, entitled "The Star Pocket-book." This book not only serves as a guide to the constellations, but also shows how the stars may be used for determining time and directions. There are tables showing the dates when certain stars cross the meridian at midnight, and the highest altitudes of stars in various latitudes. There are also lists of "simul-transit pairs," *i. e.*, stars which transit at the same time, and which, when vertical, mark the meridian.

The Photo-electric Photometer.—The use of the very sensitive photo-electric cell in stellar photometry was first suggested less than three years ago, and has thus far been realized most successfully by Messrs. Guthnick and Prager, whose results were published in Vol. 1 of the publications of the Babelsberg Observatory. The improvement of this instrument has recently been undertaken by Prof. Joel Stebbins, who has been so prominently identified with the selenium photometer. A form of the instrument, as perfected by Professors Stebbins and Kunz, at the University of Illinois, was used last summer with the 12-inch refractor of the Lick Observatory in measurements of the light-curve of Beta Lyrae, and an account of this work has just been published as a Lick Observatory Bulletin. The instrument consists essentially of a rubidium cell in direct connection with a string electrometer, which hangs in gimbals on the end of the telescope. It is very sensitive to the effects of moisture, but no trouble from this source was experienced in the dry air of Mt. Hamilton. It has a color sensibility about half-way between the visual and photographic methods of photometry. The measurements on the variable star Beta Lyrae, which has a period of 12.92 days, were made on 34 nights, and, while agreeing in general with previous visual measurements, show a number of curious irregularities that demand explanation.

Albedo of Planets as an Indication of Rotation Period.—A note by Mr. W. F. A. Ellison, in the *Journal* of the British Astronomical Association, argues against the long rotation period (equal to the period of revolution) sometimes ascribed to Venus. If the planet always turned the same face to the sun, the illuminated hemisphere would probably be without moisture, while the dark hemisphere would be in a state of permanent glaciation. Water once conveyed to the dark side would remain locked up there as eternal ice. Evaporation from the ice, at the temperature of space and under an atmospheric pressure probably much greater than that at the surface of the earth, would be almost *nil*. Hence the illuminated side of the planet should be entirely free from cloud, and we would see the actual surface of the planet just as we see that of the moon. If this were the case, Mr. Ellison believes that it would be impossible to explain the high observed albedo of Venus, since "there is no known substance, of which a planet's surface could conceivably be composed, which could reflect light as the surface of Venus reflects it." The high albedo appears to mean that what we see on Venus is a layer of cloud. This is, of course, contrary to the views of Lowell and others, who think they have observed permanent markings on this little-known planet. Similar considerations make it necessary to reject the hypothesis of M. Amaftounsky regarding the markings of Jupiter. The albedo of this planet, even higher than that of Venus, indicates a cloud surface, such as has been assumed by nearly all modern astronomers. On the other hand, Mr. Ellison finds on the surface of Mars, as seen with his 18-inch reflector, spots so dark that their albedo must be not far from zero; and this, he believes, indicates deep water—in other words, seas—instead of the tracts of arid land of current interpretation.

Radio Communication

Government Experiments with Direction Finder.—It is reported that the United States Government is conducting a series of experiments with direction finder apparatus installed in the radio station situated at North Truro, Mass. The purpose of the experiments is to enable navigators to send signals to the wireless station and then be told the vessel's bearing.

Early Direction Finder Patents Sustained.—The priority of invention by Alessandro Artom of triangular dirigible aerials and the radiogoniometer as set forth in Italian patents Nos. 88,765 and 88,766, French patent No. 378,186, and German patent No. 203,139, has been sustained by the Italian courts recently. Bellini and Tosi, whose work in developing systems of wireless direction finding is well known, heretofore have claimed priority in the case of the radiogoniometer, which is the essential instrument in their system.

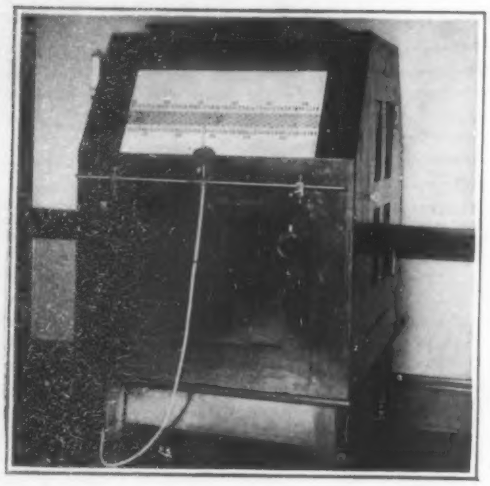
Review of Wireless Telegraphy.—The United States Bureau of Navigation has issued a monograph entitled "Important Events in Radiotelegraphy" which gives, besides the history of the wireless telegraph itself, the important steps in electrical development which led logically to the invention of this means of communication. There are special chapters on "Some Recent Developments," "Radio Inspection Service," and "Wireless as a Safeguard to Life at Sea." There are fourteen pages of events by dates. Copies of the publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at five cents each.

Proposed Wireless Stations for Spain.—According to information recently published in the official organ of the Seville Chamber of Commerce, a company has been organized with a view to operating wireless telephone systems in the different cities of Spain and to connect with the Spanish vessels and Spanish colonies in Africa. The proposal contemplates the erection of stations in the cities of Cordoba, Seville, Cadiz, and Huelva, and 29 other stations in other parts of Spain, in the Canary Islands, and at Tangier, Melilla, Ceuta, and Ibiza, in Africa. The first-class stations are to be of 5 kw. and the second of 2 kw. rating.

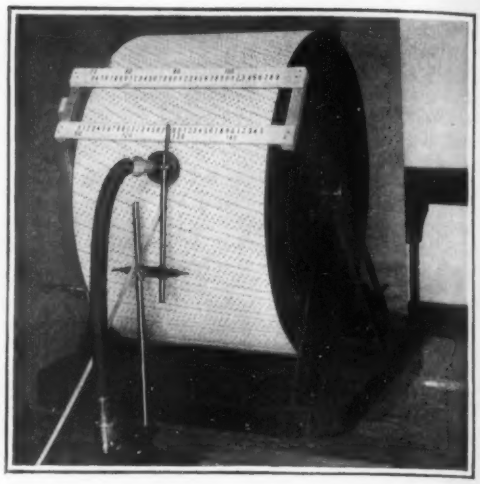
A Detector Based on New Principle.—There has recently been perfected a crystal detector the operation of which is based on an entirely new principle. Instead of the crystal coming in contact at one point only with a sharpened metal rod or fine wire, as is usually the case, the surface of the crystal makes contact with the minute particles of a finely divided alloy. Thus there are almost innumerable contacts in the detector, which is made in the form of a small insulated disk with a knurled edge for adjustment purposes. To adjust the detector, it is only necessary to turn the disk slowly while listening to the varying strength of the signals in the telephone receivers.

Radio Communication in the North Sea.—The story of a correspondent who spent an evening in the wireless room of a British battleship stationed in the North Sea illustrates the great range of many present-day radio stations. On that particular evening, which he admits was unusually favorable to wireless communication, he heard Poldhu, the Welsh station of the Marconi chain; Nordeich, the German station from which the Teutonic version of the war is sent out daily to ships at sea; the Eiffel tower station at Paris, which handles a goodly part of the French Government's orders to distant commands; the Spanish station at Madrid; the Russian naval commander in the Baltic, as well as the admiral of the British Grand Fleet, the German commander-in-chief with his land-locked fleet, and the British commander-in-chief in the Mediterranean. The correspondent comments on the ease with which the operator was able to tune in any desired station while eliminating the others.

How the "Goeben" and the "Breslau" Evaded the Allied Fleet has until now remained a mystery, although everyone has heard of the successful dash of these two German warships from an Italian port to Constantinople, despite the seemingly impenetrable net of Allied fleets, during the opening days of the great war. A book which is attracting much attention in Germany contains a semi-official history of the adventures of these two famous ships. According to its author, Emil Ludwig, the German Admiral's strategy was to give the enemy the impression that the Teuton fleet was making for the Adriatic, and then suddenly swing east in a dash for Constantinople. However, an English cruiser happened on the spot and saw the maneuver when the ships swung into another course. And to prevent this warship from signaling to the British ships, which were waiting off Malta and the Straits of Otranto, the German radio operators received orders to "jam" the enemy messages, which they are said to have successfully accomplished. As a result, the all-important dispatches were not received until hours later, when all chances of intercepting the fast German ships were gone.



Standard model tonoscope, suitable for voice culture



Simple model of the tonoscope, showing the mechanism

Using the Eye Instead of the Ear in the Training of a Musician

By Carl E. Seashore

A DEAF person can now train himself or herself to sing or play any instrument correctly without the aid of an instructor. In other words, the study of music has been reduced to a science; and instead of depending upon the sense of hearing for determining the purity or correctness of a sound, the eyes are resorted to in studying an animated screen.

The device which has made the foregoing possible is known as the "tonoscope," and although it is not, strictly speaking, a novelty since the first model was built in the psychological laboratory of the University of Iowa in 1902, it is of current interest because of its recent development to the commercial stage.

The tonoscope works on a principle analogous to motion pictures, technically known as stroboscopic vision. It converts the sound vibrations into pictures on a screen. The screen, which may be seen through the opening on the front of the tonoscope, has 17,500 dots which are so placed that, when acted upon by a sensitive light, they arrange themselves in characteristic figures for every possible pitch within the range of the human voice. Each figure on a graduated scale points to a row of dots on the screen which indicates the pitch. The dots are arranged in 109 rows: the first row comprises 110 dots; the next row 111 dots, and so on, each successive row having one more dot than the preceding one until the last row is attained which comprises 219 dots. When a sound of a particular pitch is caused to act on the tonoscope, the row which has the dot frequency that corresponds to the vibration frequency of the tone appears to stand still, while all the other dots continue to move, and thus tend to blur. It is the row which "stands still" that indicates by a corresponding number on a scale the pitch of the tone. The screen is arranged for readings covering but one octave, but tones above or below the octave can be read on the same screen by multiples. The conditions under which a reading is made with the tonoscope are absolutely natural, since in conjunction with a dectaphone, acousticon, or even the ordinary telephone the tone may be registered without the use of a speaking tube or horn, and even from a distant point.

The mechanism of the tonoscope is not as complicated as might be supposed at first. The revolving screen carrying the dots is driven by a synchronous motor which runs in step with a 10 v.d. tuning fork. The sound waves to be analyzed cause a manometric flame to flicker, and the resulting intermittent light selects those moving objects which synchronize with the vibrations of the tone and the light. The manometric capsule used may be equipped either for the direct transmission of the sound waves through a small trumpet, or it may have electrical connections with a highly sensitive telephone, as previously mentioned.

The reading of the apparatus, which is in terms of vibrations and the accuracy of which varies with the steadiness of the tone measured, is instantaneous. The moment one sings or plays a note the pitch of that note in terms of the number of vibrations per second can be instantly read. The record of the instrument is very much finer than the ear can hear; accordingly, it not only furnishes an objective record of pitch, but also magnifies details. The tone from a tuning fork can be read to an accuracy of 0.1 of a vibration, the fractions of vibrations being obtained by timing the passing of a slowly moving dot.

It is only recently that the tonoscope has been developed to a point where it may be used for teaching the inflections of the voice to the deaf. It seems that this appeal to the eye will furnish a short cut and, indeed, new possibilities for attainment in pitch control of the voice of the deaf. The tonoscope is also available for the conservatory, where it serves a wide variety of purposes, not the least of which is the development of the voice. A singer, standing before the instrument, sees in clear form every pitch movement of the voice: he sees exactly how many vibrations per second the vocal organs are producing, and thereby can tell, at the very moment of singing a note, what error is involved, even down to the hundredth of a note. The singer can practice before the instrument by the hour with the opportunity of seeing the error in every tone, and controlling the voice and the ear by the eye. He can study in detail the attack, the sustaining, and the release of a single note. Likewise can the player of the violin, flute, cornet, or any other musical instrument use the tonoscope to advantage. A scientist or a musician may take a phonograph record of the tonal effects under observation and ship the cylinder to the laboratory where it may be reproduced upon the tonoscope. The student of primitive music can transcribe the phonograph record by this method, while the scientist can undertake technical studies on pitch which involve exact measurements and instantaneous recording in actual singing. Again, the student of public speaking can study the inflections of the voice objectively and train for mastery. Finally, the teacher of the deaf can place his pupil before the instrument, and train him to speak with pleasing inflection of the voice by practicing with the aid of the eye. These applications, it is believed by the author who, in conjunction with Dr. C. F. Lorenz, has invented the tonoscope, are but a few of the many uses to which the instrument will ultimately be put. It would appear that it is not in the adapting of the tonoscope to various purposes that ingenuity will have to be exercised in the future, but rather in finding almost countless new uses for this valuable apparatus.

Deaf person learning the inflection of the pronoun "I," for which he has a diagram at the right. He practices until his voice produces the same diagram on the tonoscope

Seaweeds as a Commercial Fertilizer

IT is reported by the United States Consul stationed at Yarmouth, Nova Scotia, that through experiments with seaweeds by the Dominion Government Reduction Works at Clark's Harbor, N. S., it is found that they are rich in potash and possess a considerable quantity of nitrogen and phosphoric acid. Seaweeds in their natural state have long been used by farmers in Nova Scotia for manurial purposes, and the fact that they readily decompose when spread upon the ground seems to enhance their value as a possible commercial fertilizer. Fresh seaweeds, however, contain 65 to 85 per cent of water, which makes it unprofitable to ship the fresh material any distance inland. The government is now trying to find a method by which seaweeds may be dried and ground economically.

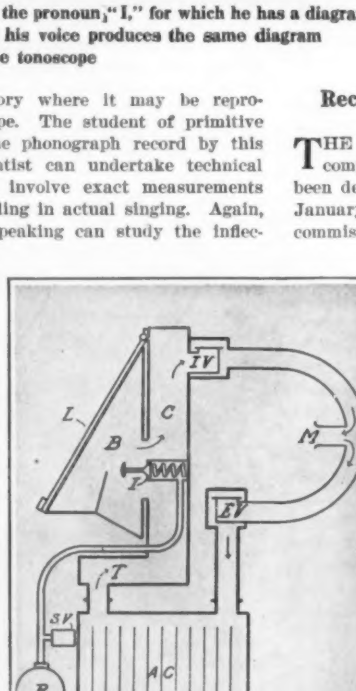
Recent Developments in Mine Breathing Apparatus

THE United States Bureau of Mines announces the completion of a new breathing apparatus which has been developed after much study and experiment. In January, 1914, the Director of the Bureau of Mines commissioned Mr. Wm. E. Gibbs, a mechanical engineer of New York City, to undertake the investigation of the problems involved and to construct a new type of apparatus in which the results of his research should be embodied. Columbia University very kindly placed a laboratory at the disposal of the Bureau of Mines for this purpose. The result of all this is a self-contained, automatically-regulated apparatus carried wholly on the back of the user. The new equipment is believed to set a new mark in the field of mine breathing apparatus.

Rescue crews have to do hard work in the poisonous atmosphere of a mine after an explosion or fire, and the breathing apparatus they wear must be of the best design and construction. It must be absolutely reliable; it must supply an artificial atmosphere of great purity; it must be as light as is consistent with strength, and it should impede the movements of the wearer as little as possible.

A few words on the process of respiration will help to make clear what follows:

Normal air contains 20 per cent of oxygen mixed with about 80 per cent of nitrogen and a trace of carbon dioxide. At each inspiration part of the oxygen combines in the lungs with carbon, which is brought to it by the blood, and the air when expired contains about four per cent of carbon dioxide. The nitrogen of



Mine breathing apparatus developed by the Bureau of Mines, showing the equipment with the cover removed and a diagrammatic explanation of its operation

the air is unchanged by the act of respiration and takes no active part in it.

For all practical purposes an artificial atmosphere of pure oxygen, or oxygen containing only a small percentage of nitrogen, is actually preferable to normal air under the conditions surrounding mine-rescue work. In spite of the general belief that pure oxygen is unsafe to breathe, no abnormal effects attend its use unless it be breathed for a much longer period than that during which rescue apparatus is customarily worn, and even then the only symptom noted is a slight irritation of the bronchial passages.

The amount of oxygen consumed in the body is precisely the same when the gas is breathed in a pure state as when it is diluted with nitrogen in the form of air. There is no flushing of the face, no feeling of exhilaration, no increase in the pulse rate, nor elevation of arterial tension. It is only a few years since the reverse of each of these statements was believed.

If, on the other hand, the oxygen content of the air be materially reduced, unconsciousness and death are almost sure to follow without any warning symptoms, provided the carbon dioxide content is kept low. For this reason it is advisable that breathing apparatus shall supply an atmosphere rich in oxygen. Moreover, much of the oxygen that is made from liquid air contains two or three per cent of nitrogen, and as this remains unchanged in the apparatus, analyses of the air breathed by the wearer generally show a decreasing oxygen content proportionate to the length of time the apparatus has been used. If the proportion of carbon dioxide in the artificial atmosphere rises much above two per cent, deeper breathing or panting warns the wearer of danger, generally in time to let him get to safety.

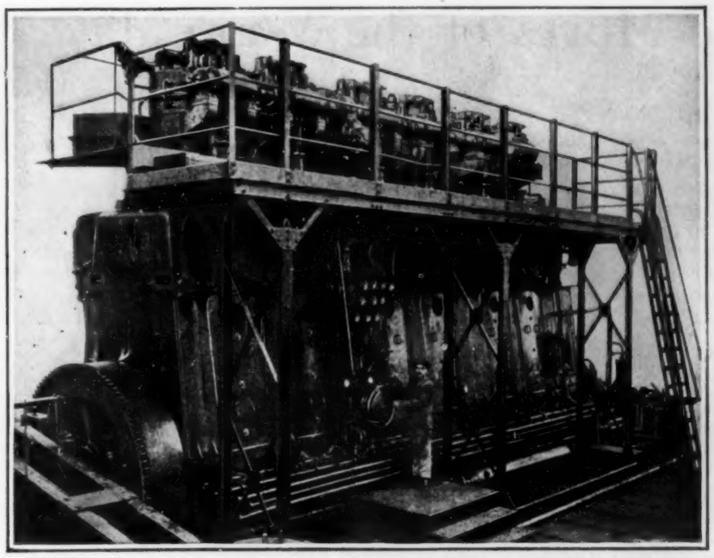
The elements that enter into the construction of the Bureau of Mines breathing apparatus are shown diagrammatically in the accompanying drawing. The apparatus is supposed to be full of oxygen and to have a considerable surface of caustic soda exposed in the absorbing cartridge *AC*.

When the subject inhales through the mouthpiece *M*, the valve *IV* opens and oxygen passes from the bag *B* through the cooler *C* to the lungs. On exhalation the oxygen, somewhat diminished in volume and containing about four per cent of carbon dioxide, issues from the mouth. The valve *IV* now closes, but the valve *EV* opens to let the mixture of O_2 and CO_2 gases pass into the absorber *AC*, where the caustic soda combines with the carbon dioxide to form sodium carbonate (Na_2CO_3) with the formation of some water and the liberation of heat. In existing types of breathing apparatus potash salt, which is more expensive, is used.

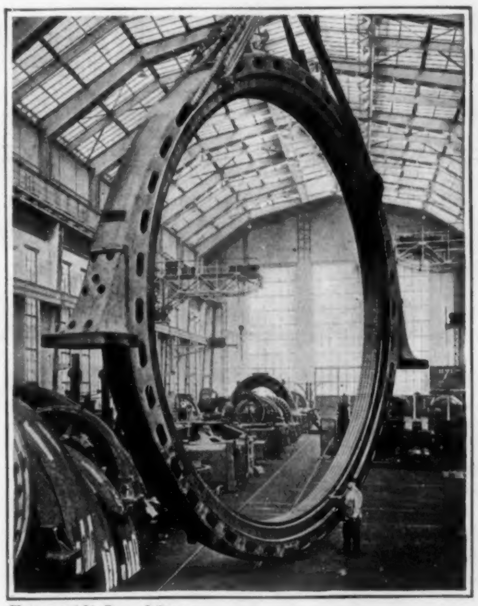
Thence the purified oxygen passes by way of the duct *T* to the breathing bag *B*, which expands to make room for it. The total volume of gas then in the apparatus is less than the original volume of carbon dioxide taken up by the absorbing can. After the wearer of the apparatus has taken a few breaths, the bag *B* collapses sufficiently to permit the weighted lever *L* to open the oxygen admission valve *I*, when the bag *B* fills again automatically. The heat generated in the absorber is removed from the gas by radiation, partly from the cooler *C* and partly from the bag *B* and the connecting tubes. A reducing valve *R* lowers the pressure of the oxygen from about 2,000 pounds per square in. in the bottle to a pressure that may be controlled by the admission valve *I*. A pressure gage *P*, indicates the available oxygen. The gas may be turned off by the stop valve *V* when the apparatus is not in use. *SV* is a safety valve with a whistle in its outlet, which blows off at half an atmosphere. The whistle is to give warning of leakage at the reducing valve.

Breathing apparatus, as previously constructed, employed a constant flow of oxygen from the tank of compressed gas, not because such a flow is desirable, but because of the difficulty of making a reducing valve that permits the flow to be interrupted. With such a system it is necessary to set the valve to deliver oxygen at a rate that supplies the demands of the wearer when putting forth his utmost exertion. At all other times the supply is excessive and the surplus must be allowed to escape through a relief valve. Besides being wasteful of oxygen this method causes considerable fluctuation in the pressure within the apparatus, and at all times makes breathing difficult. Thus, one of the most important parts in the new breathing apparatus is the reducing valve which represents a long series of experiments. When the reducing valve is attached to a cylinder of gas at a pressure of 150 atmospheres the pressure within the bellows, when the outlet is closed, is about one sixth of an atmosphere. This remains constant even after the outlet has been shut off for several hours. Such a reducing valve makes it possible to admit oxygen intermittently to the breathing bag in the exact quantity required by the user under conditions varying from complete rest to extreme labor.

Exhaustive tests with the new apparatus, which weighs 30 pounds complete, are reported to have demonstrated its superiority over most existing types.



Large two-cycle Diesel engine of 2,300 indicated horse-power, two of which are installed in the Brazilian submarine depot ship "Ceara"



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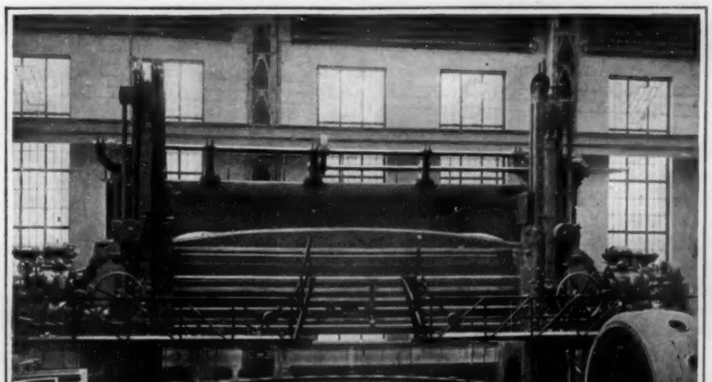
Frame of an electric generator with the pole pieces in place



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Horizontal lathe finishing the frame of a huge electric generator

A Giant Diesel Engine

THE internal combustion engine, on account of its immense usefulness and universal applicability, occupies a great amount of public attention, and those engaged in producing this class of motors are generally assumed to be in the forefront of mechanical progress. But a survey of the entire field, including every class of motor, raises the question whether the progress so far made has been adequate, or commensurate with what might reasonably have been expected.

Except in a few directions, the impression forces itself that practically there has been no radical improvement in the internal combustion engine for many years, and that such progress as has been made has been almost entirely in the direction of refinements of old principles and designs, and more accurate workmanship; and in these lines there has been more of imitation than originality. Possibly one reason for this is that the builders of engines have exploited particular limited types so intensively that they neither care nor dare to make any material changes, for it is notably difficult to induce the buying public to move in a new direction, no matter how much to its advantage.

Unfortunately there is, aside from these commercial considerations, another side of the matter that directly concerns the engineer, and this is his conservatism, and even narrowness of view. To be definite, the case of the four and the two-cycle motor may be cited. It is obvious that an engine that gives but one working stroke out of four is a mechanical anomaly, and yet we hear of no effort to make any change, and although the two-stroke principle is theoretically twice as efficient as the four-stroke, even this improvement is not only disregarded by the majority of gas engineers, but even condemned out of hand by men who have practically no knowledge of the subject. If a fraction of the investigation that has been given to the four-cycle machine had been devoted to the two-cycle principle it is safe to say that the two-cycle engine would have superseded its more popular brother in many directions before this.

What can be accomplished in designing an engine on the two-cycle principle is shown by a pair of large motors recently built in Italy for the Brazilian navy, notwithstanding the often repeated statement that the two-cycle Diesel engine was a failure, and their construction has been entirely abandoned. These engines, which are for the submarine depot ship "Ceara," are not only the largest marine Diesel engines yet built, but they are also the most compact, the lightest and the most economical, and, withal, the simplest.

The "Ceara," for details of which we are indebted to *Engineering*, is a vessel of 326-foot length and 4,100 ton displacement, and is powered with two two-cycle engines of the Diesel type, each of 2,300 brake horse-power when turning 130 revolutions a minute. The cylinders, of which there are six in each engine, are 24.8 inches diameter and 35.4 stroke, and 384 brake horse-power is obtained from each cylinder, without overloading them. The four-cycle engines of the "Fiona," one of the largest of its type, with cylinders of 29.13 by 43.30 give but 270 brake horse-power each. Some other comparisons with a six-cylinder four-cycle engine of 1,450 brake horse-power are interesting. The "Ceara" engines are 30 feet, 6 inches long over all, and 16 feet, 6 inches total height from center of crank shaft, with an over-all width of 7 feet. The four-cycle machine is 46 feet in length and 18 feet high, with the same width. The "Ceara" engines weigh 155 pounds per brake horse-power, while a four-cycle engine of equally solid construction would weigh 250 to 350 pounds per horse-power.

The Electrical Industry in Belligerent Germany

DESPITE the great numbers of men who have been drafted into the army and the tremendous demand for war material that has caused almost every machine shop of any importance to be converted into an arsenal, there is being produced in Germany much electrical machinery, to which the two accompanying illustrations bear evidence.

Measuring over 35 feet in diameter, the frame of the generator shown in the two views represents an interesting piece of mechanical work. The rough castings comprising the frames have been finished in a gigantic horizontal lathe, after which the pole pieces are bolted in place, ready to receive the coil windings.

Strategic Moves of the War, May 5th, 1916

By Our Military Expert

AFTER almost five months of siege the British forces under General Townshend at Kut el Amara have been compelled to surrender. This force, which originally constituted the flying column which attempted to take Bagdad, was reduced at the time of surrender to something less than 10,000 men. Shrinking to this almost negligible number of men was brought about by losses incurred during the advance on Bagdad, the retirement from Ctesiphon and the subsequent investment of Kut.

General Townshend's surrender was primarily caused by lack of food, ammunition, and the dearth of equipment to meet sanitary needs. His lines of fortification were not carried by the enemy; no assault which the German-led Turkish forces were able to launch had more than dented his defenses; there was no chaotic crumbling of his stronghold beneath the pounding of superior artillery. In the strictest sense the downfall of this force was not accomplished by a feat of arms, for the seasons and the flooding of the lowlands by the waters of the Tigris, thereby preventing the relief expedition from reaching Kut, although at the time of the surrender it was held by the Turks less than 20 miles away, combined to create a situation wherein the shaking of England's prestige in Asia became an accomplished matter.

The position at Kut is a strong one in a military sense, for the Tigris makes a great loop at this point which, in itself, establishes a safeguarding obstacle. With the massing of Turkish forces south of Bagdad, the expeditionary forces, of which this surrendered 10,000 is but the remnant, were forced to beat a hasty retreat, only daring to pull up when this strong position of defense was reached. Kut had been a basic point; and, with its occupation in force by the British, quantities of supplies and ammunition were sent up by boat. The augmented Turkish forces were then able to surround the position entirely, whereby all means of reaching the besieged, without successful and personal escort by a powerful relieving column, were out of the question; with the personal valor which has signalized the stand of Englishmen on every field of battle the depleted British forces settled down behind their lines. There is a tradition of Great Britain's that if any besieged forces can but hold out for sufficient time, relief columns will hew a way through. True to form, as soon as news of the Kut investment became known, a more powerful relief column was dispatched to its aid from the head of the Persian Gulf. But the forces of the Ottoman had gathered; the organization of Teutonia had come to weld the loose parts and the English force was held away from its objective, in this case by force of arms. Townshend's supplies were rapidly becoming scarce; efforts were made to relieve the wants of his men by sending them small quantities of food and medical necessities by aeroplane, but for some reason this was a failure. All the time through the long weeks and months, the British kept up hope. They could clearly hear the guns of the relieving column engaging those of the Turks, so near to the southward; their scant rations were halved that a few more days of endurance might be provided. In a desperate attempt to reach Kut, a ship laden with necessities was sent up the Tigris, with the deliberate intention of running the gauntlet of Turkish fire; but as the beleaguered garrison watched and prayed, the ship grounded only 4 miles away; and with this deprivation, hope fled and Townshend surrendered rather than see his men starve.

This expedition has been called another piece of Great Britain's folly. For decades England, Russia, and Germany have contended diplomatically for the hegemony of Asia Minor—with all apologies to Turkey. To date, English influence has somewhat overshadowed that of Russia; Germany's hold on this section has been almost entirely commercial, abetted by a very quiet and able diplomacy.

What seemed a splendid opportunity for physical control presented itself, and, with customery disregard of conditions, England dispatched an utterly inadequate force in a thrust toward Bagdad; and Kut el Amara is the result. With the great Russian armies of the Caucasus, so far victorious, sweeping down, to the northward, the possibility of England's political predominance in this section seems to have vanished in Russia's favor. As possession is nine points of the law, even of nations, Germany's claims may not be advanced unless a general decision is obtained by her.

With no bias in favor of Teuton or *Entente*, this miserable failure in Mesopotamia adds but another link to the chain of errors which Great Britain seems to have forged since the war began. There were grave differences of opinion between the British and the French commanders during the retreat from Belgium, wherein the safety of the entire line was jeopardized, with England unaccountable. The Dardanelles fiasco was Britain's, naval and land; and now, Mesopotamia! England has not yet become enough of a military machine to meet the needs of the day.

The character of the country in the vicinity of Kut el Amara is such that military movements must be greatly restricted. The land to the southwest of Kut is so low that during the spring it is almost entirely under water for miles. Directly north of that reach of the Tigris which runs from Chubibat to Kut, there are great marsh lands, secure rest for a flank of Turk and British relief expedition alike.

Townshend had no choice. He could not retreat, either southward along the Shatt el Hai or northeast, along the Tigris, for he was hemmed in. And the lines which inclosed him from the eastward were almost back to back with those which confronted the relieving force. There was no chance for either contender to turn the other's flank, for inundated areas prevented; and neither side was in sufficient strength to undertake direct and sustained frontal attack, with its necessarily tremendous losses. As a matter of fact, Townshend could probably have stood his ground for five months more, except for the very obvious reason that his men must live to fight, and must eat to live; he was starved out.

Scene of the British failure in Mesopotamia

While it is true that climatic reasons had much to do with the failure of these last British operations, had the Bagdad venture been delayed until an adequate force—say that which attacked the Dardanelles—had been assembled for the purpose, then the movement would probably have carried through.

From a military point of view, the loss of Townshend's force is of comparatively little moment; an ordinary assault at Verdun has cost far more. And it is to be doubted whether the Turkish forces released for activity in other fields by the surrender are sufficient to materially sway any balance; England's relief column is too close at hand to be neglected, and Russia's columns, reaching toward Bagdad from Kermanshah, are not alone, for they are supported by others north and south.

The cost to England therefore, of this, her latest failure, will probably not have to be paid during the war; but if the *Entente* should win in the end, the bill will be presented, for Russia should then hold the proverbial "Nine Points of the Law," the physical occupation of Asia Minor, to England's exclusion.

Automatic Type-Setting Machine for the Oriental Languages

A RECENT issue of *Commerce Reports* contains a number of interesting facts concerning the "Orientype," an automatic type-setter designed to set up the thousands of type characters used by Japanese, Chinese, and Chosen printers.

According to the correspondent writing in the *Commerce Reports*, one of the new machines has been set up recently in the printing office of the *Hawaii Shinpo*, a Japanese daily published in Honolulu. S. Sheba, editor of the *Hawaii Shinpo*, was at last able to realize in material form the dream of years—a machine which he believes will revolutionize Oriental printing—after a visit to the Panama-Pacific International Exposition at San Francisco in 1915. He visited Machinery Hall many times, and after seeing so vast an array of machines he was able to formulate in his mind the manner in which some of the intricate parts of his typesetting invention should be made. Under his personal supervision the original model was made in Honolulu, and a real machine was manufactured in San Francisco. The inventor purposes to obtain a patent.

The "Orientype," to some extent, has the appearance of a miniature Brooklyn Bridge. In the center and below the "bridge" appears a keyboard. This is to extend the full length of the "bridge," and the operator will use a sliding seat set in grooves. The pieces of type are placed in rectangular-shaped tubes of brass and are released by springs, in their turn released by the keyboard. The type is carried to one end of the "bridge" on a perpetual belt carrier and then falls into a part of the mechanism which resembles the familiar matrice-assembling mechanism of the linotype.

Since there are 5,000 characters in use by Japanese and Chinese printers, Mr. Sheba has also invented a system of classification of type into about 100 units. These are collected in the rectangular tubes. The tubes are again classified by notches on the outside, somewhat after the form of those on Yale keys. These fall upon a set of wires and are carried on these by the notches. In this way the filled tubes are classified, and the operator selects a number of tubes, places them over the type-setting machine, their lower openings set so that the springs released by the keyboard set them upon the endless belt, and the characters are carried to the receiving fonts.

The inventor is preparing his machines so that in the near future, with the models in a commercially successful form, his product will be disposed of not only in Japan, China and Chosen, but also in the United States, as there are Oriental printing companies upon the American mainland. He hopes to displace the old laborious system of selecting, setting up, and assembling type characters.

American printers who have read the meagre details available concerning the "Orientype" are of the opinion that the machine should be a very expensive one to build. Further, they claim that its very complexity may stand in the way of its universal adoption, for the Oriental printers may find hand-setting cheaper than the cost of operating the machine. Obviously, of course, their opinions are based only on the facts available.

Soldering of Aluminum as a Substitute for Welding

BECAUSE of the impossibility of soldering aluminum satisfactorily in the past, this metal has not been used to the extent that its high utility otherwise justifies. Workers in aluminum have heretofore been obliged either to weld aluminum pieces together or to resort to a more or less satisfactory soldered joint, the latter difficulty being due to the impossibility of keeping the metal free from oxidization.

There has recently been introduced a new form of aluminum solder for which the claim is made that it will not only join two pieces of the metal together every time, but it will also make a joint that will be stronger than the aluminum parts. The new solder will do a better, quicker, neater, stronger, less expensive and more lasting job than by the welding process, it is claimed.

The new aluminum solder is said to be the only solder that runs at a very low temperature, and when cold is not only harder than aluminum but has more than twice the strength. A simple experiment that shows how much stronger the soldered portion is than aluminum itself is to solder two pieces of sheet or cast aluminum at right angles to each other. When the soldering is complete, an attempt is made to break the two pieces apart. Invariably the aluminum pieces will break before the soldered portion.

The simplicity of soldering with the new aluminum solder is another point in its favor. All that is required is a gasoline torch. The job to be done is heated; then, with slight rubbing with a hack-saw blade or a piece of iron, the metal and solder will combine without a flux of any kind.

War Game—IX

The Defense

By Lieut. Guido von Horvath

THE general principle of the defensive is to utilize all of the advantages of the situation, both tactical and strategical, with the intention of assuming the offensive when the opportune time arrives.

Under some conditions, defensive positions may be selected and prepared far in advance. In other cases, the commander of the forces which are obliged to remain on the defensive for the time, may maneuver so skillfully as to enable him deliberately to occupy certain positions which the enemy must either attack or fail to accomplish his mission.

Again, the commander is liable sometimes to lose the initiative and he may be compelled to accept battle on the ground available. In this latter case, a successful defensive is most difficult.

But in all cases, the underlying principle of the defensive must be the same. Its aim must always be to hold the initiative or to gain it.

It makes no difference what natural or artificial advantages are in question, the loss of liberty in maneuvering and the possible lost initiative are not compensated by the best defensive position.

Therefore, the sole reason for taking up a defensive position should be to hold the enemy by means of smaller forces in such a way that after equalization of the defensive combat, the defending force may undertake the more active operations necessary to win a decisive victory.

Selection and Preparation of a Defensive Position

The first duty of the commander is to secure all the information available as to the enemy. To secure this information, the intelligence department, cavalry and aerial reconnaissance must be utilized.

The most important items of information to be secured are the lines of approach of the enemy and the strength of his forces. Until this is learned it is better to keep the force in a position of readiness under the protection of a strong outpost line. Thus the forces are kept in hand ready for any emergency.

The amount of preparation depends mainly on the time available and the demands of the task to be undertaken. In choosing the defensive position, great care should be exercised not to make the line too long to be held by the force in hand. By lengthening the line and thus requiring the services of too many of the troops to hold it, the chance of assuming the offensive will diminish. It is evident that a long line will be a weak line.

In selecting a defensive position, the terrain and its natural advantages or disadvantages must be first considered. An effective fire being the most decisive factor in a defensive action, a clear field of fire both to the front and flanks, without cover for the approach of the enemy, is the first requisite.

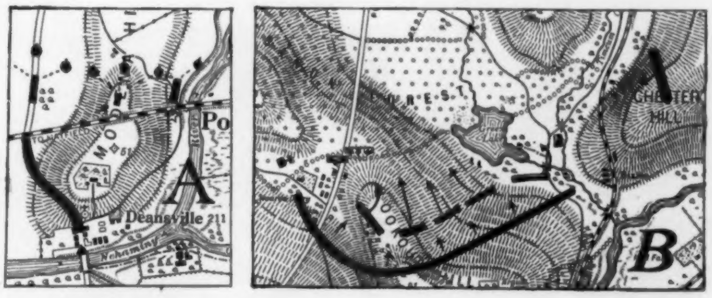
When selecting a defensive position, the artillery should be so located that it may direct its fire upon the advancing enemy until the last moment in case of an assault, without interfering with the action and fire of our own infantry. A position should be chosen the terrain of which will permit and if possible favor a counter-attack. If there is any chance for an enveloping movement by the enemy, or for an enfilading fire by him, the defensive line is exposed to a grave danger.

The defenders must retain their liberty for maneuvering. This is dependent upon the depth of the position and means of communication under cover.

Cavalry can be of great use to the defense in delaying the enemy, in screening our positions and by forcing the enemy to make an early deployment. Carefully screened supporting positions on the flanks which can enfilade the approaching enemy with a surprise fire, are of great value.

In the distribution of the force in a defensive position, there are two elements of the force to be considered. The first is the firing line in the trenches, with its supports and local reserves in the cover trenches. The second is the general reserve held in readiness at some favorable point behind the line. The general reserve is the force with which the commander intends to turn the tide of battle and to assume the offensive when the opportune time arrives.

The firing line must be manned according to the demands of the combat. Weak points will need stronger forces while strong positions may be held with ease with a few troops. The artillery should be concealed as much as possible and gun positions be constructed which offer good cover. It is wise to place part of the artillery with the general reserve. But when so placed with the reserve, a position in observation should be selected so that it may take its part in the combat without need of change. Every available minute should be utilized to strengthen the defensive line. The stronger the artificial protective features, the smaller will be the number of men required to hold it.



Corrected diagram of situations in War Game VII, at (A) 10:30 P. M. and (B) 5:40 A. M.

[Owing to an error on the part of our engraver, the situations depicted on page 453 of our issue of April 29th, 1916, were misplaced on the map. The correct positions are here given.—ED.]

The line of trenches need not necessarily be a continuous line. On an uneven or broken ground, this line would be far from a continuous or straight line. It would be rather a series of supporting points following a general line.

In preparing a defensive position, the main idea should be to improve the field of fire. Distances should be measured to furnish accurate ranges; marks for such ranges should be established on the field and the defending troops should familiarize themselves with these marks so that they may make ready use of them.

The trenches should be constructed with the view, first of all, of providing the best opportunity for effective fire. Secondly, they should have good cover and concealment to the defenders, ready means of communication for the supports and means of supply of ammunition, food and water. The control, if possible, should be by means of the telephone.

Hill-tops are not ideal places for trenches. It is true that they provide easy communication to the rear, but they are too exposed and are very seldom found without dead spaces on their front, that is, sections which cannot be swept by fire from the trenches. Trenches located at the foot of the slope are easier to conceal and allow a good grazing fire over the whole foreground.

Concealed supporting trenches for surprise fire, which are not to be used until a favorable moment arrives, are of great importance.

The trenches for the reserves should be deep and provided with communicating trenches for approach to the firing line.

It is wise to prepare emplacements for the guns to be used when the offensive is taken up.

With these considerations of the general principles of the preparation of a defensive position, we can return to the Red detachment commanded by General G, south of Pottstown, and follow the results of his orders for taking up a defensive position.

To make the situation as clear as possible, we shall go to the tower of the City Hall, from which observation point a good view can be had over all the level country.

A Defensive Position in the Making as Reported by an Eye Witness

"I reached the highest window in the tower of the City Hall at Pottstown at 4:00 P.M. The country to the south and southeast was spread out before us as flat as a map. It was as peaceful and calm as a summer day. But suddenly it changed and unusual activities were in evidence. Many small bodies of troops moved eastward, their starting point seeming to be the small wooded section on the main road south of the railway crossing. On the main road to Norrisville, a troop of cavalry trotted along while another emerged from the eastern section of the town. The advance guard and some patrols preceded this last troop across the fields and soon overtook the ant-like infantry patrols.

"By 4:30 P.M., the whole southern section was humming with busy workmen. Everything was chaotic at first, but the longer I watched, the more I realized that the military organization was working with a most efficient system.

"The battalions marched out and were halted at their alloted places, arms were stacked, and equipment was placed on the ground. Then spades and picks were brought out. Officers on horseback and on foot were busy taking measurements, pointing hither and thither and giving directions. Then, as the realization came to me, I saw that these troops were constructing a long ditch which stretched from the Nehaminy Bridge to the Creek. Even south of the Creek, around the Manor House, some soldiers were working.

"The artillery, numbering eight or nine guns, rode out to Ash Inn and the artillerymen began to dig under the shade trees behind the Inn.

"A movement attracted my eye and for the first time I saw some engineers at work near the first bridge that crossed Conestoga Creek just above the swampy

(Concluded on page 515)

Sketch of Red defensive position

A—Firing trenches. *B*—Communicating trenches. *C*—Cover trenches, for supports. *D*—General reserve. *E*—Trenches for flank protection. *F*—Artillery positions. *G*—Advanced trenches.

A Survivor's Impressions of the "Sussex" Disaster and Observations in London and Petrograd

By Edward H. Huxley

We commend to the careful attention of our readers the following impressions of a survivor of the "Sussex" and his personal impressions of the situation in Europe. Mr. Huxley's long business experience and his position as President of the United States Rubber Export Company, which have brought him into close touch with leading men in the commercial life of Europe, lend special authority to this illuminating article.—Editor.

THE journey which was interrupted by the torpedoing of the "Sussex" was commenced in January and was intended to be of not more than six to eight weeks' duration, including visits to England, France, Spain and Portugal. It was later extended to include Russia, and the developments which occurred soon after my arrival in London caused me to take the Russian trip first, postponing the trip to the western continental countries until later. The trip to Russia, which was thought to present greater danger than the balance of the trip, was without especial incident. Few ships were in sight at any time in the passage of the North Sea from Newcastle to Bergen, and no war ships. From Bergen the journey continued via Christiana and Stockholm to Petrograd, all by rail, the only entrance to Russia now available from the west being from the Swedish frontier town of Haparanda to the Finnish frontier town of Tornio, both located at the extreme north end of the Gulf of Bothnia, thence south and southeast through Finland to Petrograd. At Haparanda, the entrance into Finland, we were from early morning until after seven o'clock at night undergoing the various examinations. All luggage and each passport were rigidly examined both by the customs officials and by the military authorities.

There is a more or less noticeable difference between conditions at London and those at Petrograd. Aside from the darkness of the city of London at night, there is little evidence of an abnormal condition other than the great number of officers and soldiers in uniform constantly in evidence. Business in the City appears to go on about as usual, and the streets are crowded with pedestrians and vehicles. At night the theaters are well patronized, as are the restaurants and cafés, and everyone seems cheerful and happy. The great number of officers in the restaurants, cafés and theaters at night is easily and legitimately accounted for, as they are all officers from the front on two to four days' leave, and are entitled to all the pleasure that they can crowd into that time. One seldom sees the same face twice. In Petrograd, while some of the theaters are open, the life in the restaurants and cafés is greatly changed; they must close not later than 11 o'clock, and are usually not more than half or a third full, and there appears to be a complete absence of gay social life. Prohibition of wine and spirits is as complete as it ever can be, and there is a spirit of dogged earnestness which is especially noticeable to those who have visited Russia in peace times and seen the completeness with which the Russian gives himself over to pursuits of pleasure. The River Neva, frozen over and deeply covered with snow, has been transformed into a battlefield, with snow forts and trenches, and recruits are constantly being drilled, preparatory to leaving for the front; most of the open squares of the city are also filled with troops at some time during the day, all being carefully prepared to fight. They are splendid, stalwart specimens and well equipped. The most serious problem in Russia to-day is that of transportation. The Government and the business men are sadly in need of material of all kinds, but it is difficult, and at times impossible, to transport the goods. The day I departed was the first day for a month that there had been passenger traffic between Moscow and Petrograd, the lines being wholly given over to the transportation of freight. Archangel is in an indescribable condition; freight is stacked up for miles, with little prospect of relief, and the railroad is congested beyond anything that we can conceive from experience in America. It is hoped that the new port of Kola will afford some relief, but it will be some time before this is available. There is no direct railroad from Archangel to Petrograd, freight passing south until it joins the trans-Siberian railroad at Vologda, whence it goes westward to Petrograd. The

Courtesy of Illustrated London News

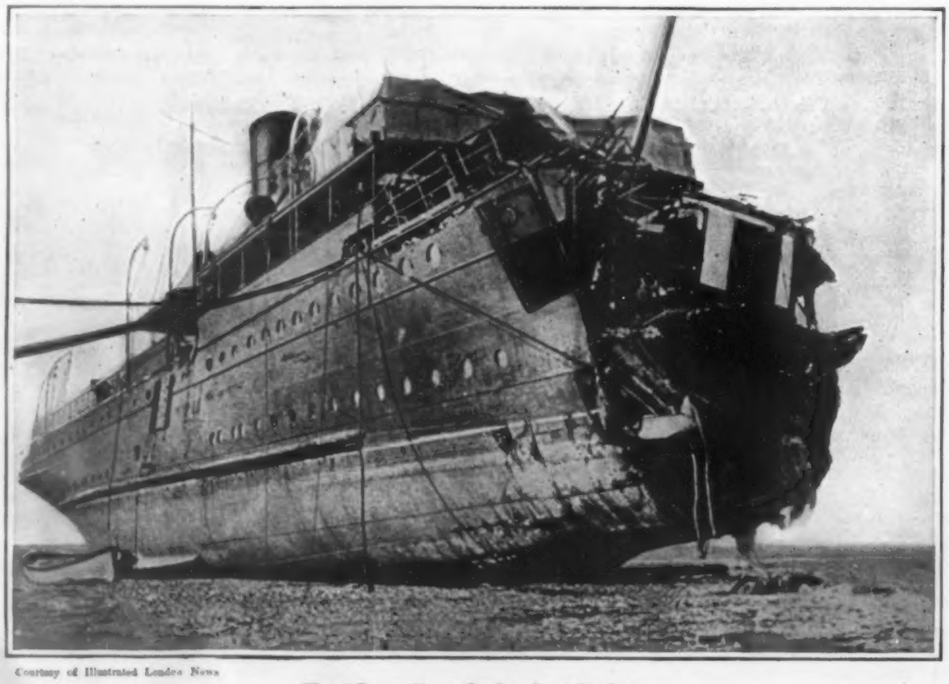
Survivors on the bottom of an overturned lifeboat

Government is working actively to relieve these conditions, but until entrance can be obtained from the south there must always be a more or less unsatisfactory condition. There is a great shortage of coal, and one of the largest industrial concerns, the Russian-American Rubber Co., is burning daily the product of over four acres of timberland, all of the trees being of full growth. Prices are somewhat, but not materially, higher than in normal times.

The sentiment in Sweden, particularly in Stockholm, among the business men, appears to be undergoing a change. Early in the year there was scarcely anyone who was not confident of the ultimate success of the German arms. The campaign at Verdun, in conjunction with the general trend of events since the first of the year, has seemed to shake the faith of Sweden in Germany, and a feeling is manifesting itself that perhaps after all German organization may not be impregnable. The sentiment in Sweden, however, must always be considered in the light of the hereditary enmity between Russia and Sweden existing for hundreds of years. Sweden, it should be said, is profiting greatly commercially by the sale of its products to Germany, but is rigidly maintaining its prohibition of export of many lines of goods.

The return to England was accompanied by the same vexatious delays, as travel in England itself nowadays is surrounded by more difficulties and formalities than was ever the case in Russia in peace times. The exit from and entrance into England may only be effected after rigid examination and the compliance with many formalities. Somewhat more shipping was observed on the return trip, including more war vessels, one of which was a British submarine, seen just at the entrance to Newcastle harbor. Once the formalities are passed, however, traveling in England is more expeditious than in other countries. The same dogged determination that one would expect and that one observes in Petrograd is present in England, and there is no thought but of ultimate victory, and all plans are being laid to that end. While total prohibition of spirits does not yet exist, there is the most rigid curtailment of the consumption of spirits, and only from 12 to 2 and from 6:30 to 9 may purchases of wine and spirits be made, and even then they must be consumed within half an hour after the time of closing, and all restaurants must be closed at midnight.

The departure from London for the cross-channel trip was on Friday, the 24th of March, at 9:30 A.M., from Charing Cross Station. The time of departure is changed with each trip, there being three crossings per week, and the train on the previous Wednesday had departed at 8 o'clock at night. The time of departure may be ascertained only by personal application at the station, the object, of course, being to render the time of actual crossing unknown and different each time. The formalities at Folkestone being finished, the ship was boarded and proceeded on schedule, at 1:30 P.M., out of the harbor, passing a troop transport crowded with Tommies, who exchanged cheers with us as we went by. The day was delightful, sunny, warm and with a smooth sea. All went well for an hour and a half, until 3 o'clock. The vessel passed an enormous number of ships of all kinds, either steaming or anchored, and this rendered all the more conspicuous the total absence of shipping later, when we most needed assistance. The explosion occurred without warning of any kind, at 3 o'clock in the afternoon, and was of such a violent nature as to completely destroy and carry away the entire forward third of the ship, and it seemed that the remainder must soon sink and disappear. There were six lifeboats only. The first boat to be filled and lowered was overturned immediately upon reaching the water, and most of the occupants were drowned, a few only out of possibly twenty-five or thirty climbing on top of the overturned boat. The second and third got away safely with their full quota, possibly thirty, of

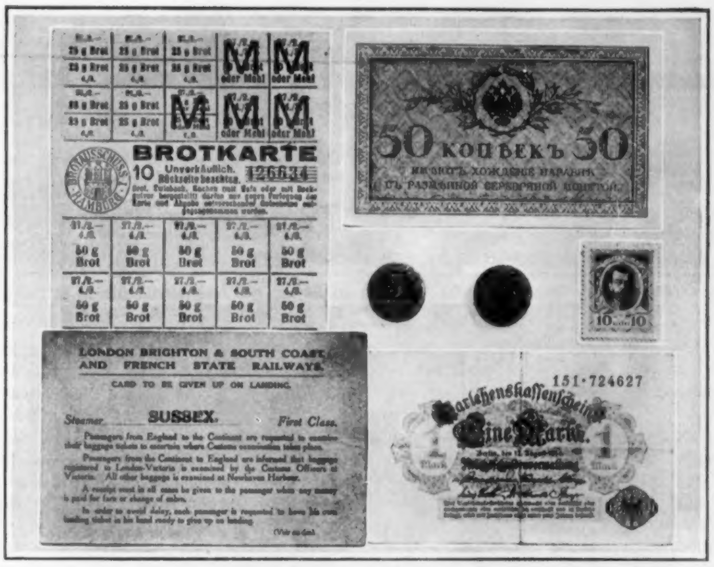


Courtesy of Illustrated London News

The "Sussex" on the beach at Boulogne

which a good portion were women. The fourth proved unseaworthy and was abandoned. The fifth got away with only five or six men in her, and the sixth again went off well loaded. All of the boats leaked and required constant bailing.

After all the boats had gone it remained for the rest of us who were still on board the hulk to determine what should be done. As the ship, even though so grievously damaged, had not immediately sunk, it appeared to me improbable that she would sink suddenly, and that she might indeed remain afloat. I watched a spot on the outside of the ship near the water carefully for ten minutes and found that there was no evidence of settling. I assumed, therefore, that immediate action was not necessary, and that sufficient warning would appear to give opportunity of swimming for it, if that became necessary. In company with two or three other Americans who had been uninjured, we all gave our attention to those who most needed it, and, unfortunately, there were only too many. We worked for some time in the wreckage in the forward part of the boat and succeeded in digging out five grievously



Souvenirs of the Great War

A Berlin bread card (Brotkarte). A "Sussex" ticket that was never "given up on landing" Russian 50-kopek paper money. Obverse and reverse of a German 5-pfennig *iron* coin. Russian postage stamp, with notification printed on back making it legal tender. A German paper mark.

wounded men and two women. These we made as comfortable as might be, although the fact that there was no medical man among the passengers and that we could find no medical stores, made the work of relief somewhat difficult and inadequate. The decks were covered with water and débris as a result of the explosion, and all of the wounded forward had to be handled with great difficulty and, unfortunately, with little regard for their comfort. The principal thing was to get them on to the deck and to wrap them up so they might be warm. After an hour, a more or less official examination of the ship having taken place, it was announced that the danger of sinking was remote, and the three lifeboats were recalled and the passengers again taken on board, this unfortunately being again accompanied by some loss of life. It would appear that many of the officers and most of the crew of the ship were destroyed in the explosion, and the bulk of the work of rescue was done by the passengers. At no time did I see an officer of the ship directing the work. Had it been realized at first that the after part of the vessel would continue to float, the most serious

(Concluded on page 514)

The volunteer Patrol Squadron running in the teeth of a snowstorm

The Patrol Squadron

Privately Owned Motor Boats Pledged to National Defense

IN our issue of January 1, 1916, we showed a sketch of the proposed boats of the first Volunteer Patrol Squadron. Since that time five of these boats have been placed in commission, and in both speed and seaworthiness they have more than come up to the requirements decided upon by their owners when the question of design was submitted to Mr. A. Loring Swasey, a well-known Boston naval architect, who designed these boats.

On May 1st Secretary Daniels issued a circular letter addressed to the owners of yachts and motor boats, in which he states that the Navy Department is desirous of mobilizing for the purposes of defense the privately-owned yachts and motor boats of this country which, in construction and speed, would fulfill the requirements of patrol service.

The Secretary further states that it would be highly desirable to have a large fleet of motor boats, similar in design, which, in case of necessity, could be immediately employed for patrol service. This announcement of the Navy Department's policy towards motor boats was anticipated by a number of public-spirited men, who decided to inaugurate a movement for the defense of this country against hostile attack, and they decided to build several boats of one design which could be employed as patrol boats in case of necessity. Accordingly, a movement was started and an organization formed, which is known as the Patrol Squadron, and a fleet of five boats was built as a nucleus, as well as for the purpose of demonstrating the usefulness of boats of this character.

Part of the flotilla tied up at the dock

On Friday, April 28, 1916, Assistant Secretary of the Navy, Franklin D. Roosevelt, who has been the father and moving spirit of this project, inspected the Patrol Squadron in Boston harbor, and was extremely pleased at the speed of the boats and the way in which they could be maneuvered while running at full speed. The boats themselves are primarily adapted for use in connection with the patrolling of the coast and harbors to prevent hostile attack by submarines, as well as in assisting their own submarines, acting as dispatch boats and patrolling mine fields. Each boat is approximately 40 feet over all, with an 8 foot 9 inch beam and a 30-inch draft. They are equipped with 135 h.p. engines, which give them a speed, approximately, of 27 miles per hour. Their owners have had them so constructed that in case of necessity a larger engine can be installed, so that a speed of over 30 miles per hour can be attained. These boats have been tried out in a heavy sea, and they were found to be very seaworthy. Each boat is equipped with wireless having a sending radius of about 100 miles, and each one will mount a one-pounder, rapid-fire gun for offensive work against submarines. The boats themselves have ample room for the accommodation of a crew of four men in time of peace and six men in time of war. At the present time each boat has a crew consisting of a lieutenant, two signalmen, one being a wireless expert, and an engineer.

The commander of the Squadron is Mr. Stuart Davis of Southampton, L. I., and in addition there is a Squadron Quartermaster, a Squadron Surgeon and a Supervising Engineer.

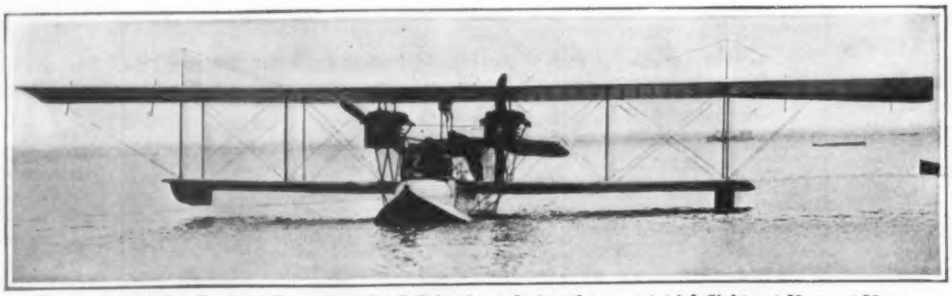
There will be a practice cruise in June, and from September 5th to 12th the Squadron expects to join in maneuvers under war conditions in conjunction with the battleships and other vessels which have been assigned by the Navy Department to constitute the training fleet. It should be mentioned that these staunch little craft will have a cruising radius of several hundred miles without refilling their fuel tanks. Furthermore, the plans and specifications of these boats were submitted to the Bureau of Construction and Repair and were approved and indorsed by the Bureau. They are similar, it will be noted, to the patrol boats which are doing such excellent service in European waters.

Running at 27 miles per hour

Banking on a sharp turn

The Trend of American Aeronautics Toward Giant Aircraft

PREVIOUS to the war American builders of aircraft, despite their small numbers and the lack of encouragement both from the Government and the general public, had set a new mark in the form of the "America," the flying-boat with which the transatlantic flight was to be undertaken had Europe remained at peace. But the "America" was a unique instance; otherwise, the Americans left to their European confreres the task of developing the multiple-engined aeroplane of large proportions.

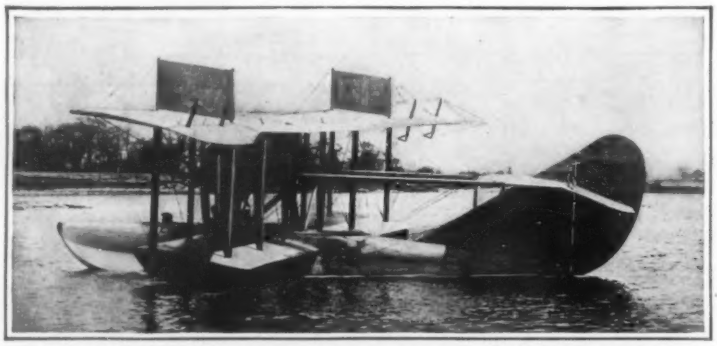


Front view of the Curtiss "Super-America" flying-boat during the recent trial flights at Newport News, in which eight passengers were carried with ease

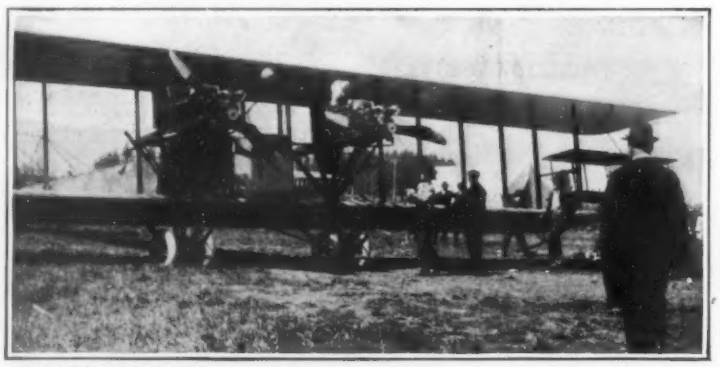
Since the war, however, the necessary impetus has been given the American aeronautical industry. The demand of the fighting countries for larger and more powerful aeroplanes and hydro-aeroplanes has been heard and answered not only in Europe but in America as well. The result has naturally been the appearance of a number of successful machines of great power, size and lifting capacity.

The first of the giant flying-boats built by Curtiss and known as the "Super-America" received its initial test at Newport News on April 24th. Two flights were made with the machine carrying eight persons.

As might be supposed from its name, the "Super-America" type closely follows the lines of the first "America" which was developed two years ago. The body of the present type is nearly 40 feet over all. The upper wings have a spread of 80 feet, and two 160-horse-power engines each weighing about 500 pounds propel the machine through the air at a speed of about 90 miles per hour. The pilot sits in the rear, well in back of the wings; the passengers, on the other hand, sit in a cockpit well up towards the front of the boat body. Because of the large surface which the fuselage offers to side winds and gusts, it will be noted in the accompanying illustrations that two small vertical wings or fins have been placed on the upper wing, ostensibly to prevent side drifting. The sturdy construction of the entire machine is to be admired and commended; one conspicuous instance is found in the method of mounting the stabilizing planes on stout outriggers. The hydroplane member of the craft is V-shaped and provided with side fins to facilitate leaving the surface of the water. It is estimated that the useful load that can be carried by the "Super-America" flying-boat is 2,800 to 3,000 pounds.



Curtiss flying-boat of the "Super-America" type, presented to the Coast Guard by the well-known American aircraft builder



The twin engines of the huge battle cruiser, showing the peculiar bracket mounting of the power plants

The craft tested at Newport News was held out of a consignment for the British government and presented to the Coast Guard with the personal compliments of the designer and manufacturer, Glenn H. Curtiss. It is reported that the present plans of the Coast Guard are to install a powerful wireless set on the craft with a view to using it as a patrol in seeking and reporting derelicts by radio. It is believed that the flying-boat will be either able to destroy the wrecks or stand by, even on a rough sea, while summoning assistance.

Turning our attention from the water to the land, it is learned that a large and powerful aeroplane has recently been tested at Sunnyvale, Calif., under the pilotage of Roy Francis. The spread of the upper wing is 72 feet, while the over-all length of the machine is 40 feet. The machine, which weighs about two tons and is propelled by two 120 horse-power engines, can carry nine or ten passengers.

The new aeroplane presents many novelties in construction according to the accompanying illustrations. Perhaps the foremost of these is the peculiar method of mounting the twin engines. Instead of incorporating the engines into the structure of the aircraft, as is usually the practice, the builder of the present machine has placed them well in front of the planes, on a sort of bracket construction. In the absence of details concerning the tests and in view of the fact that the machine has not yet been tried out in actual service, it would be little short of speculation to criticise the mounting of the engines, which appears to be unsatisfactory as judged by present aeronautic practice. The ailerons are also of a novel design in that they are of the biplane type, which recalls to mind those used on pioneer machines. Taken as a whole, the aircraft does not appear to possess the sturdiness that would be expected in a machine of such ambitious proportions.

The successes attending the use of the new aeroplane in actual service will be followed with great interest. The craft is intended as a battle cruiser for the Army, it is stated, and has been inspected by Government officers. It is to be shipped to San Diego, Calif., in the near future.

Current Supplement

THE *Sun Temple in Mesa Verde Park*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2106, for May 13th, describes and illustrates some recently discovered ruins of the ancient cliff dwellers that dates possibly back to 1300 A.D., and discusses the possible purpose of this structure, which is being restored by the Government. The valuable lectures by Sir J. J. Thomson on *Radiations from Atoms and Electrons* are continued in this issue. *Ancient Mesopotamia* tells something of the ancient history of the region about Bagdad, and the system of irrigation canals that once made this country one of great fertility and riches. It is accompanied by a map. *The Dandelion* tells of a plant for a long time regarded almost as a weed, but which is now being regularly cultivated both for its tops and its roots, which have a medicinal value. The article is illustrated. *Food Economics* considers the question of human sustenance as suggested by war-time conditions. In *The Future of Ship Propulsion* a comparison is made of various systems of power and the arrangements of propellers. The article on *Great Electro Magnets* is concluded. Other interesting matter includes *Shoal Water Corals; Notes on Plant Chemistry, Aeroplane Stability, Transparency of the Atmosphere in Central Australia*, and a number of shorter articles.

The Tractor with Drive Wheel in the Furrow

IN our issue of April 3, 1915, we published an article on the small farm tractor, in which the following statement appears: "In the design of one tractor the drive wheel runs in the furrow and, undoubtedly, creates a hard pan similar to the share hard pan formed by one horse's feet and the plow share." It now appears that the Bull Tractor Company, of Minneapolis, Minn., was at that time the only company manufacturing a tractor of this design, and that it emphasized this exclusive feature.

This company has filed with us the originals of a large number of voluntary testimonial letters and copies of several hundred letters from owners of its tractors that came in reply to an investigation following our publication of the above quoted statement. They offer overwhelming evidence that the Bull wheel running in the furrow does not pack the ground, but quite the contrary, as the wheel, being equipped with long spade lugs from 3½ to 5 inches in length, acts as a subsoiler—in fact, many owners of these tractors state that they have dispensed with their subsoiling device.

After reading this evidence, we are convinced that the author of our article was in error in making the statement referred to, and we are pleased to take this opportunity of correcting the false impression that may have been created by it.

It always has been and always will be the policy of the SCIENTIFIC AMERICAN to give a square deal, and if an unintentional wrong has been done, we are pleased to correct it.

Huge, twin-engined biplane of the battle-cruiser type built in California and intended for the United States Army. It embodies several unusual features in its construction

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

How Machinery is Replacing the Human Element in Book Binding

By G. T. Carliss

WHAT would our grandfathers think if they could witness 60 complete copies of a 1,000-page magazine, the signatures or sections collated in the proper positions and wire-stitched, the cover glued on, and all stacked ready for bundling, turned out every minute? Yet the sight is a common one in the modern periodical and catalogue bindery, where machines known as gatherers are doing much towards reducing still further the human element in the manufacture of printed matter.

A representative gathering machine is 65 feet long, weighs 16,570 pounds, and is built to accommodate pages of printed matter ranging 7 by 10, 9 by 12, and 10 by 14 inches, and for any number of sections, which are known in the parlance of the trade as "signatures" or "forms," desired. Forty feet of the machine's total length is devoted to the actual gathering of the signatures. Thirty-six compartments are provided for extra large magazines or catalogues.

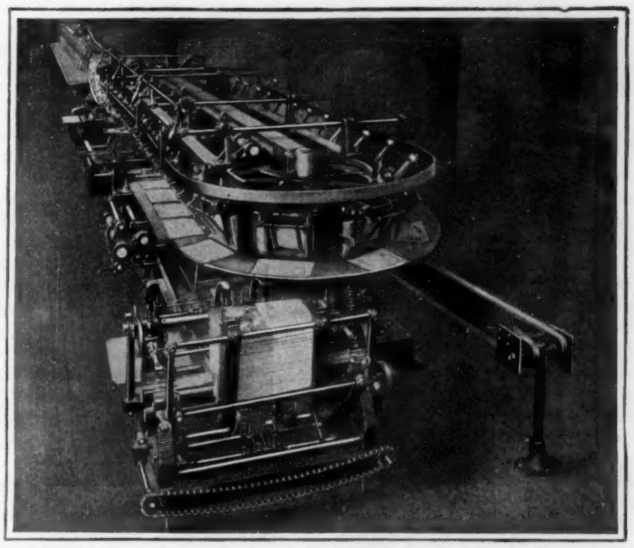
Magazines, pamphlets, catalogues, and books can be gathered, glued and wire-stitched on the gatherer; and the number of girls required to feed the signatures is governed by the number of signatures or forms of the books being bound. The signatures are stacked in the compartments and can be replenished by placing a further supply on top of the stack, without stopping the machine. In the gatherer that was examined by the author some four, eight, sixteen and thirty-two page forms, together with single sheets of colored plates, were being bound up.

One girl is required to feed every six compartments with the proper signatures; also a male operator and one assistant for the entire machine. Sometimes the girl feeder places the wrong signatures in a compartment, but where the human being is liable to error the mechanism of the gatherer is not; for at the moment the incorrect signatures reach the handlike members or grippers, the machine instantly stops. A line of 36 of these grippers extends over the 40 feet of the gathering end of the machine, one gripper facing each signature compartment; and these same grippers can be used for any sized signatures by adjusting the fingers at their free end. So fine is the adjustment of these fingers that an extra sheet of tissue paper will stop the entire 65 feet of machinery. The delicate adjustment is effected by the centering of a piece of hardened steel passing through a measured space. If the signature grasped is of the correct size to conform to the original setting, all is well; but if the signature deviates even to the slightest extent from the setting of the grippers, the hardened steel piece is raised and hits a throw-off arrangment which in turn throws out the main driving clutch and releases a powerful friction brake. As soon as the correct signatures are placed in the section at fault, the machine can be instantly restarted.

A suction pump operated by the machine forms part of the equipment. It is provided with branches that connect with each signature compartment. At the proper moment the suction pipe at each compartment sucks into convenient position the bottom signature as the humanlike grippers draw the correct signatures from the various compartments and deposit them in a steel trough running parallel to them. Along the bottom of the trough moves a conveyor, which is timed to receive the various signatures at the proper period so as to insure the pages running concurrently.

As the complete set of signatures reach the end of the trough, they are gripped and turned on their backs, the long way down, and enter a sleeve which squares or jogs them so that they will be ready to receive the wire stitches which are to bind them together. The wire stitching mechanism is a delicate piece of machinery. Steel wire is drawn from a large reel and fed through a stapling machine, which is firmly gripped in a vise operated by two eccentrics. The wire, which has been shaped into staples, is forced through the book and clenched by a small die on the reverse side, all in the fraction of time allowed.

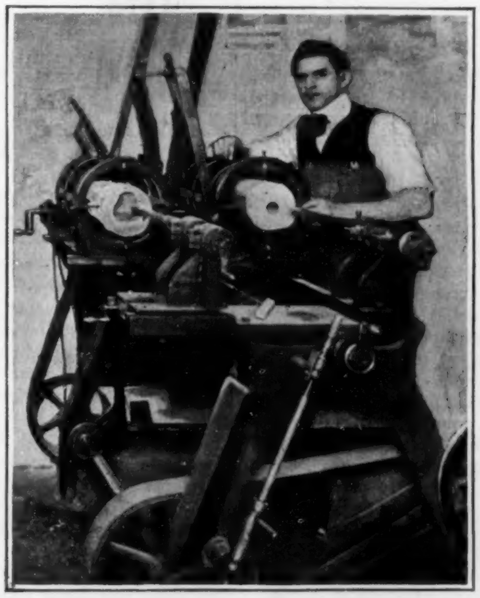
The book, which is now assembled but still lacks a cover, continues on its journey, arriving at an electrically-heated pot of elastic glue. Fixed in the center of the glue pot is a brass wheel knurled on its outer circumference and revolving in the opposite direction to that in which the book is traveling; the wheel is mounted just high enough to impart a thin but uniform coat of hot glue on the back edge of the forms. The book is now ready to enter that part of the equipment known as the covering machine.



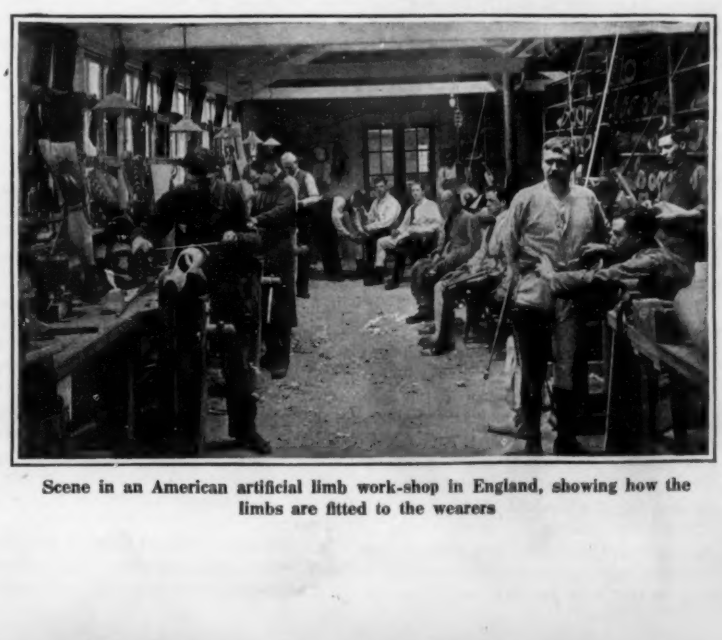
End view of a gathering and covering machine which automatically gathers the forms, binds and covers them to form a complete book or periodical

The covering machine is oval-shaped and is supplied with a number of arms that seize the books and keep their leaves closed and in an erect position, ready to receive the cover that is being automatically fed from a large pile at the extreme opposite end to the gathering mechanism. The covers are drawn from the bottom of the pile and conveyed in very much the same way as the signatures in the gatherer, on a steel conveyor and timed to reach the under side of each book the moment the latter has received its coating of glue. If, through any fault of the mechanism, the cover for the book has not been brought into position, the gluing wheel remains depressed and allows the book to pass over without glue, thereby saving the book and keeping the track clean and in condition to continue operation. The uncovered book can later be returned to the track ahead of the gluing wheel. When the cover is in position a small die, operated like a steam hammer but only working from underneath, gives the cover a smart tap which presses it firmly in place. At the same instant the arms of the oval-shaped covering machine pick up the overlapping leaves of the cover and carry the book to the final outlet of this wonderful mechanism. The completed books are deposited in a neat pile, ready for bundling and subsequent distribution.

The covering machine does not necessarily have to be operated in conjunction with the gatherer proper. If desired, a hopper can be used to supply many and various sized books to be covered. The books in some instances may be gathered by hand, yet so remarkable is the versatility of the mechanism that covers are readily applied to them. The covering machine can also be employed in binding books without staples, so that they will open out flat.



A reproducing lathe in which a piece of wood is properly formed to correspond with a plaster cast



Scene in an American artificial limb work-shop in England, showing how the limbs are fitted to the wearers

Manufacturing American Artificial Limbs in England

By G. R. Thomas

PREVIOUS to 1914 the demand for artificial limbs in England was small in comparison to the consumption in this country. This was no doubt due to the better protection for life and limb provided on the railroads and in the various manufacturing and mining industries. For these reasons the development of this interesting and humane art was rather neglected, and such firms as did manufacture artificial limbs did so as a part of a general surgical supply business. Meanwhile America produced a number of firms which have specialized on these articles and have developed them to the highest point of perfection; and to-day, American artificial limbs are acknowledged to be far superior to all others.

When the present great conflict in Europe began to get well under way and the casualty lists mounted higher and higher, the British government formulated a plan for immediately taking care of the large number of men who had lost arms and legs in battle, instead of waiting until peace was declared. To accomplish this result convalescent hospitals were established in Roehampton House, Roehampton, a suburb of London, loaned by Captain Wilson, and in Dover House, an adjoining estate, loaned by Mr. J. P. Morgan, of New York.

The foregoing-mentioned hospitals are supported partly by the government and partly by private contributions. They are complete in every detail. The best medical attention is supplied and every convenience contributing to the comfort and entertainment of the men is provided. All sorts of amusements are indulged in and schools have been established for the purpose of training the men to become useful members of the community instead of objects of charity as has so often been the case in the past. They are taught stenography, bookkeeping and other light occupations which adapt themselves readily to their conditions, and an employment bureau finds positions for the men when they are discharged.

As soon as a man is able to be moved from the base hospital at the front, he

is brought to one of these convalescent hospitals and kept there until he is provided with an artificial leg or arm, as the case may be, and is then either discharged from service with a pension, or put into clerical or other light work for the War Office.

To supply the necessary limbs, work-shops have been erected in the hospital grounds and each limb is made and fitted under the personal supervision of the authorities.

Naturally, the English manufacturers were soon swamped by the unprecedented demand and after careful investigation several American firms were invited to demonstrate their products. At the conclusion of the investigation, work-shops were erected for several American firms and these are now supplying a large portion of the limbs.

The improvised work-shops are carefully constructed one-story structures and are completely equipped with specially designed machinery, tools, power and other requisites. They comprise comfortable measuring and fitting rooms and large, convenient wood-working and finishing shops. The limbs are usually made in a rough state in all sizes and shapes in the American shops and in this condition are known as "setups." Large stocks of these setups are kept in London and they are constantly being shipped from America. After a man has been measured, a setup is selected and this is finished up to fit him.

The fitting is accomplished in several ways by different manufacturers. The usual procedure is to take a plaster cast of the stump or point of amputation and to shape the socket of a leg or arm to correspond with this cast. In some instances this is done by hand with the use of draw knives, while in other instances it is accomplished with the use of a reproducing lathe. The latter is an interesting and novel machine which receives a block of wood in one basket or holder and the plaster cast in another. A roller coming in contact with the cast controls the lateral movement of a cutter mounted on a spindle, which reproduces the exact shape of the cast in the wood in an absolutely accurate manner. This fitting of the stump into the socket is the most important phase in the making of an artificial limb, for unless the fit is absolutely right, no matter how good the rest of the construction is, a man will be unable to wear the limb and it will be useless. It follows that the utmost care is necessary in this operation, and the greatest skill and judgment must be exercised.

After the socket is completed, the rest of the leg is shaped up and adjusted to the proper length. It is then covered with rawhide and enameled or varnished as required.

Not the least important part of the manufacture of artificial limbs is the selection of the wood used. This must be light and very tough, and of good, straight grain. High willow and second growth hickory are mostly used and they must be thoroughly seasoned. Large tracts of forest lands have been purchased and gangs of men are busy cutting and seasoning the timber.

Most of the work is done in these factories by Americans who have been sent over for the purpose. This labor is of a very high class and good wages are paid. Great skill is essential and it requires years of experience for a man to become really proficient in this art. One interesting feature of the labor question is that most of the men engaged are minus a limb themselves; and these men make the best workmen, for in studying their misfortune they have come to appreciate the other fellow's trouble and give him the benefit of their personal experience.

Super-Zeppelins

(Concluded from page 503)

ten tons more than the vessels of the previous type. Some weight may also have been saved through an improved system of construction, as well as by the new 200-horse-power engines which weigh only 880 pounds, instead of 985 pounds.

On the basis of the above ratio a 33-ton super-Zeppelin carries a useful load of about $11\frac{1}{2}$ tons—more than double the load the previous type was capable of lifting. If such is the case, allowance for two tons of ammunition leaves nine and one half tons available for crew, ballast and fuel.

THE CREW.—Of the two super-Zeppelins destroyed lately, the LZ-77 carried 15 men and the L-15, whose crew was captured, two officers and 16 men. Supposing the latter figure represents the war complement of the largest super-Zeppelin, it remains to be computed how these 18 men are detailed for navigating and fighting.

The three-engined passenger Zeppelins required a navigating personnel of nine men, distributed as follows: the commander, two helmsmen and two mechanics in the front car (housing one engine); and a chief engineer and three mechanics in the rear car (housing two engines).

Although a super-Zeppelin mounts a third engine astern, it might be assumed that the engine crew has not been increased, five mechanics and one engineer being quite sufficient for looking after four engines. But in view of the super-Zeppelin's long cruising radius a third helmsman might have been added to the crew; this would leave eight men, including the lieutenant, for manning the bomb tube and the machine guns. Six men are required for manning the latter; the remaining two would then constitute the bomb-crew with the lieutenant as gunnery officer, and possibly, second in charge of navigation.

A complement of 18 officers and men represents a load of about one and one half tons; there would then remain eight tons for ballast and fuel.

THE BALLAST.—There are very good reasons for believing that the water-ballast has been considerably increased on the 33-ton airships. Vessels of the previous (23-ton) type, which carried $1\frac{1}{2}$ tons of ballast, used to navigate at an altitude of 5,000 feet and hardly ever reached the 9,000 feet mark, excepting trials; super-Zeppelins, however, often reach an altitude of 10,000 feet and are currently seen navigating at 7,000 feet.

Whereas the buoyancy of a Zeppelin is just sufficient to keep the vessel floating at a low level, great heights can be reached only through a combination of dynamic lift (expenditure of engine power) and of static lift, the latter being attained both through jettisoning ballast and burning fuel, and in extreme cases, by a forced dropping of bombs.

The question of ballast is one closely allied with that of compensating losses of buoyancy at great heights. Lack of space unfortunately forbids a detailed discussion of this subject; suffice it to say, that losses of buoyancy cannot be made up entirely by jettisoning ballast and one might assume that some artifice, possibly a system of compensating balloonets for each of the 20 or more gasbags, has been devised for remedying this defect on super-Zeppelins.

Such a course should not be astonishing at all in view of the several airships the German Navy lost in the North Sea, for the sole reason that when they came down from a great height, the gas, after having expanded, contracted through the greater atmospheric pressure and proved insufficient for insuring the necessary buoyancy. It was this phenomenon which caused the loss of L-3 and L-4, not to speak of others.

Anyhow, one can safely assume that the ballast of a 33-ton vessel is at least double that of the *ante-bellum* Zeppelin, say three tons, but more probably four tons, leaving four tons available for the fuel.

CRUISING RADIUS.—As the fuel consumption of the four-engine unit amounts to about 450 pounds per hour, four tons of fuel would keep the engines running for about 18 hours at full speed (55 knots) and thus insure a cruising radius of 900 nautical miles. The latter figure will possibly necessitate a reduction of, say 10 per cent, if allowance be made for the fuel burnt while climbing.

If it were feasible to run the vessel on the homeward journey (after she has been lightened up through the expenditure of fuel, ballast and bombs), with two engines only, the radius of action might be somewhat increased. By using the formula

$$\text{Speed at x Power} = \frac{\text{Full speed}}{\sqrt{\dfrac{\text{Full power}}{\text{x speed}}}}$$

one finds that by running with two engines the airship would develop a speed of 38.8 knots, which means a saving of 225 pounds of fuel per hour and consequently an additional cruising radius of about 200 nautical miles (9 hours at 55 knots = 495 nautical miles + 18 hours at 38.8 knots = 698 nautical miles, total: 1,193 nautical miles).

The accuracy of these figures, based on more or less plausible assumptions, cannot obviously be vouchsafed to a mile; still they seem to bear out pretty well in the light of the latest Zeppelins incursions, when some of the raiders went as far as Liverpool and Edinburgh.

Here it should be noted that the raiders which attacked these places, or at least their environs, were all reported as coming from the East, *i. e.*, from across the North Sea and not from the South, *i. e.*, from Belgium, which means that they belonged to some of the numerous "airship-harbors" which dot the German coast from Tondern (in Schleswig-Holstein) to Emden, on the Dutch frontier. The distances between Tondern and Edinburgh (440 nautical miles) and between Emden and Liverpool (400 nautical miles) would seem to bear out the assumed cruising radius of the super-Zeppelin.

As to the reason, why these vessels should choose a long and perilous journey across the North Sea rather than proceed from Belgium, one might argue that the latter course, while incomparably shorter, has been now rendered exceedingly unpleasant to the Zeppelins through the vigilant activity of the Allies' airmen and anti-aircraft guns. This the casualty list of the Zeppelins proves to the best satisfaction.

A Survivor's Impressions of the "Sussex" Disaster and Observations in London and Petrograd

(Concluded from page 511)

loss of life might have been prevented.

The foremast having been blown away, the wireless was out of commission for the time being, but was later temporarily rigged up and the operator commenced to send, and so continued. Apparently our signals were not caught for some time. At the time of the explosion there was not a single ship in sight, which was most unusual, and, aside from a sailing vessel which came in sight about 5 o'clock and then disappeared, there was no ship in sight until the first rescue ship came alongside, at quarter past eleven. There was apparently steam in one of the boilers all the time, for after nightfall there were electric lights on the hulk, and as soon as dark fell rockets and bombs were continually fired as signals of distress; but for some time there was no answer. As much of aid and rescue as could be done having been done before darkness, there was little to do after nightfall except to await a rescuing ship. A French patrol boat came in sight about 11 P.M. and, coming alongside, made fast and took off all of the women except three and most of the men, leaving perhaps fifty or sixty of us still on board, including the wounded. After loading to her capacity she made off, giving place to a British destroyer that made fast immediately after her departure. At that time, however, about midnight, half a dozen vessels were in sight, including two more destroyers that circled about the wreck within a diameter of half a mile to prevent further attack. The destroyer put an officer and six seamen aboard the "Sussex" to direct the work of rescue. We first put the three women on the destroyer, then the wounded, a most difficult and trying task, and later all of us went over and deserted the "Sussex," leaving only the dead on board. The destroyer made off at 2 o'clock and landed us all at Dover at about four.

The officers on board the destroyer were most kind and solicitous for our comfort, and everything that they had was quickly placed at our disposal. The most welcome thing, however, was the services of their surgeon in caring for the wounded, one of whom unfortunately died on the trip to Dover. The chief engineer, with whom I soon made friends, was formerly an engineer on the U. S. Battleship "Olympia" at the time she was the flagship of Admiral Dewey, and he was on her during the battle of Manila Bay. Upon arrival at Dover we were shown every courtesy, even the unusual one of being permitted to depart from a prohibited area without the usual formalities. We reached London about 10 o'clock. The cross-channel service being suspended for the time being, the trip to France was temporarily given up, as my trip having been already prolonged beyond the original plan, the two to three weeks' delay which must occur if I should go to Paris could not be thought of. I therefore returned to New York upon the first available steamer, arriving by the "St. Paul" April 14th.

That the destruction of the "Sussex" was accomplished by a torpedo appears to be beyond question, quite aside from the affidavits of those who, including the captain of the ship, saw the torpedo approach. The modern torpedo, especially that used by the Germans, is more powerful than the average mine, and it is hard to conceive of a drifting mine which would accomplish damage to the extent of completely destroying and blowing off the entire forward third of a vessel of the size and weight of the "Sussex," a vessel of nearly 1,500 tons, strong and seaworthy. The portion of the Channel, furthermore, where the explosion occurred is not regularly mined, and there had been no weather sufficiently rough to cause mines to break adrift. Again, the British mine, upon breaking adrift, becomes inoperative. From these facts the contention that the ship was destroyed by a torpedo appears to be clear, and that it could be other than a German torpedo is inconceivable. I found a piece of the torpedo while working in the wreckage, the metal being bronze or similar alloy, whereas mines are constructed of iron or steel. This again confirms the conclusion that it was a torpedo. With nearly 500 souls on board and lifeboat accommodation for not to exceed 200, had the ship sunk the disaster must have inevitably been accompanied by an almost complete loss of all lives on board. Had the torpedo also struck a little further aft and blown away the bulkhead which kept the ship afloat, the destruction must have been complete; and had the sea been running high it is doubtful if the vessel, in her shattered condition, could have kept afloat. That she did float appears to be due to a series of circumstances and conditions, any one of which having been different would have made the outcome at least doubtful.

On the following day, a tug having been sent out to search for the hulk of the "Sussex" and finding it, she was towed to the port of Boulogne and tied up, later being beached. I cannot speak too highly of the conduct of all the Americans on board. They all took an active part in the work of rescue, kept their nerve, and made me proud of being an American, and the fact that at least two were on their way to join the American Ambulance in Paris, both of whom were grievously wounded, cannot fail to justify the feeling of friendliness with which the citizens of America are held by the Allies. There should be mentioned among those working most heroically and incessantly in the work of rescue a young Frenchwoman, secretary to a French business man who was killed, and who, entirely without thought of herself, constantly labored to aid and comfort the passengers. She had lost everything and was entirely without friends and money. She was ultimately taken to the home of an English business man, and later employment was found for her on the staff of an American company's office in London.

One does not have to travel far in England to observe evidences of Zeppelin raids. Going from London to Liverpool, I passed through a railway station

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which had been entirely destroyed, and in London itself one may find buildings either pock-marked, damaged or entirely destroyed. I happened to be in Manchester at the Midland Hotel at dinner when the raid of January 31st occurred just south of Manchester. All the lights were extinguished upon news of the approach of the Zeppelins, as total darkness is the surest way to mislead the pilots. Upon news of a raid all railway traffic is stopped and lights are extinguished, and this has been the means of reducing to a minimum the damage done. As the Zeppelins usually approach England early in the evening, there is time for warnings to be sent out and the usual precautions taken.

In Stockholm I had some conversation with a prominent business man of Hamburg, and from him learned at first hand something of the conditions and sentiment in Germany. He, in common with all others, appeared to be anxious for evidences of signs of peace, and he intimated that many things that Germany had insisted upon early in the war might not be insisted upon now. There appeared to be in his mind, and perhaps a reflection of the general sentiment of Hamburg business men, a feeling that there would be no question of indemnities on Germany's part in negotiating peace, and as the statement has been made on the part of Germany many times that the cost of the war would not be upon Germany, it may be taken as significant of a lessening in confidence. He said that the Zeppelin raids and the indiscriminate attack upon unarmed cities and the destruction of innocent lives was not popular in Germany and did not meet with the sanction of the better class of German business men. Meat is prohibited three days out of each week, and that the German population keenly feels the pinch of war is a fact. Paper money, as is the case in most countries, has displaced the higher coins in Germany, and fractional currency of less than a mark in value is now made from iron. The cuts appearing show one of these iron coins, in obverse and reverse, as well as a paper mark and the famous German bread card. In England there is no dearth of silver and copper coinage, but in Russia there is no metal coinage, the fractional currency being either small notes or postage stamps engraved for the purpose, cuts of both of which are shown. The spirit of optimism so apparent in England and Russia cannot help but be reassuring as to the ultimate outcome of the war, especially when it is contrasted with the reports which come to me of conditions in Germany. Active preparations are proceeding for another winter campaign, although all hope, and many express the belief, that the coming autumn will bring the close of the war.

It is inevitable that a thinking man should contemplate, after having seen at first hand what war means, the condition of his own country and wonder what might have been the present situation had it not been for the preparedness of the British Navy and the French Army.

War Game—IX

(Concluded from page 509)

ground. Through my field glasses I saw them clearly and at first I could not understand what they were doing. Then I remembered that the springs on Goat Hill which fed the Conestoga were very copious. The engineers were evidently building a dam across the creek with the intention of inundating the swamp. In less than an hour the effects of their work were to be seen.

"As I returned my gaze to the digging battalions, I marveled at the quickness with which they worked. The first line was hardly ready before they began to dig zig-zag lines to connect them with the second line trenches. Then I saw a group of soldiers cutting hay in the meadow. Another group, having secured two wagons, disappeared in the small forest on the Norrisville road south of Ash Inn.

"At the same time officers were pacing off the ground in front and at certain spots were placing live branches as

markers and at other spots were making piles of stones. I knew that they were marking the ranges in the foreground.

"A great deal of noise of hammering and breaking of wood attracted my attention from the eastern end of the town and I decided to descend from the tower and investigate. The officers were courteous, but were firm in their refusal to let me near the houses. One officer who seemed to be in command told me: 'We are preparing that edge of the town for defense and no civilians are allowed to enter.'

"Night came and I decided that at sunrise I should be in the tower again. Thanks to the aide of General G, who commands our forces, I received permission to return.

"At daylight, the General and a staff officer were in the tower when I arrived. My first glance at the field startled me. It seemed as if the earth had opened up and swallowed the battalions, the engineers, artillery and all. Down around Goat Hill, where the day before a swampy, green meadow stood, now stretched a large lake which shimmered in the early morning sun.

"But the soldiers—I discovered only a few. The hay that the soldiers had been cutting the day before and the branches that had been brought back from the forest in the tow wagons, had all been used to cover and hide the earthworks. It was difficult even to discover the zig-zag lines that connected the two trenches. The artillery was perfectly screened.

"Just in front of the first line trenches I discovered a fence-like construction, about 80 yards from the works. These were entanglements of barbed wire.

"In the cemetery was stationed a company of infantry. A few more trenches for kneeling men were in the field ahead of the main line.

"The country was so quiet, the sun was so bright and warm, and the atmosphere was in general so peaceful, that it was hard to believe that right here, under my very feet, was *war*, ready to be let loose at any moment.

Developments and Situation of the Red Detachment

General G received the reports of his subordinate commanders at 9:00 P.M. on the 13th. It was reported that the entrenchment of the detachment had been completed. Based upon the reports received, General G issued the following order:

Red Detachment,
POTTSTOWN, 13 June, 19—

A strong detachment of the enemy is approaching from the direction of EDEN.

We will hold the position prepared in this vicinity.

The First and Second Battalions will form the firing line.

Companies I and K, of the Third Battalion, as right flank guard, will take position east of MANOR. Companies L and M will support the artillery at ASH INN

The Fourth and Fifth Battalions will form reserve and will take position at factory south of railway station. Three guns will accompany the reserve.

The engineers will assist in strengthening the position and then join the reserve.

The First Squadron will withdraw from NORRISVILLE and await further orders at BOWERS.

Battalions will establish their own aid stations.

Dressing station will be established in the Factory Building.

Ammunition will be issued at the Railroad Station.

Field kitchens and supply details will accompany each battalion.

I shall remain at the CITY HALL.

At 9:30 A.M., on the 14th, the commander of the Red forces receives several reports from the independent cavalry that a hostile brigade with cavalry and artillery is marching towards Pottstown. At 10:30 A.M., the larger portion of the second squadron appears on the hill leading from Paoly Forest to Wister Farm. At almost the same time, rifle fire is heard from that direction.

Answers to Questions in War Game VIII

Question 1. He will probably gallop ahead with the cavalry regiment as soon as the regiment reaches him at Ferguson Farm. This we presume will be at 11:00 A.M. Allowing time for the advance guard, he might be on the top of Goat Hill at 11:20 or 11:30 if he is not in so great a hurry. From this point he has a splendid view of the enemy lines and can make his decision.

Question 2. At the time Brigadier Gen-

eral LG of the Blues has reached Goat Hill, the point of the advance guard will approach the two houses on the edge of Paoly Forest. He sends the commander of the advance guard the following order:

> The enemy is entrenched south of POTTSTOWN, parallel with the railroad. Continue advance on the NORRISVILLE road to the edge of the forest. Then attack from there. I shall remain on GOAT HILL.

He summons the infantry and artillery commanders by signal, and they arrive at 12:10 P.M. He then gives them the following orders:

> The enemy has occupied a defensive position in our front. It is apparently a reinforced brigade.
> We shall break through his line at the southeast corner of POTTSTOWN.
> First Infantry will be the firing line and will attack between ALPINE Railway and the CREEK.
> Second Infantry will be the reserve and will take position in the forest in the direction of the southeast corner of POTTSTOWN.
> The cavalry will remain here under cover as artillery support and await further orders.
> The artillery will take position on GOAT HILL and will fire on the enemy battery at ASH INN. The second artillery position will be on HILL 50 to fire on the small woods and the enemy reserve.
> I shall remain here.

Question 3. Brigadier General LG decides that to send the cavalry to Norrisville is not wise under the circumstances, for the inundated territory serves as a good flank support for his detachment. At the same time, he realizes that as he intends to penetrate the enemy line, he will have good use for the cavalry when the time comes.

The ground is very favorable for a cavalry attack.

Question 4. The order of Colonel C will be:

> The enemy is in POTTSTOWN and vicinity.
> We will march to NORRISTOWN via BERRY FARM road to envelop the enemy's right flank.
> Two troops of the First Squadron will constitute advance guard.
> I will ride at the head of the main body.

The Theory of the Defense Against Enveloping Attacks, Against Double Enveloping Attack's, and Against Penetrating Attacks

The commander of the defensive forces will not know of the enemy's definite intentions until these intentions begin to show themselves on the battlefield. Therefore his main duty is to watch the enemy's actions closely, both personally and by means of his staff officers, and to keep himself posted as to everything that may happen. With the exercise of great vigilance, the enemy's moves may be counteracted or at least met half way.

The chief instrument of the defense is an accurate and well directed fire delivered at the right point and at the right time. Through this fire, and the utilization of advanced positions, which must be withdrawn in time not to mask the fire from the main trenches, the enemy may be forced to use up considerable of his reserves in advancing near enough to deliver an assault.

During the whole combat, it is not likely that the enemy will attempt a general assault covering the whole front. Such an attempt would probably prove too costly unless he has an overwhelming numerical superiority. He will usually select one point against which all of his efforts will be concentrated. This point might be either the flanks or some promising point on the front. This then is the occasion where the superior skill of the defender must repel the attempt of the offensive forces.

In most cases, the local reserves may be able to turn the tide by a well directed counter-attack. In such cases, the counter-action of the enemy will always expend more force than the attack of the defense, and will permit the placing of the bulk of the fire on the enemy reserves while deploying and exposed through the counter-attack.

Once the enemy has succeeded in gaining the distance which will enable him to attempt an assault, the greatest possible fire should be directed upon that portion of his forces, by both the infantry and artillery. If our own artillery can deliver a more effective fire by using direct instead of indirect fire, the artillery commander should immediately undertake it, even though he is exposing himself to great losses.

The general reserve, as we have stated before, should be held intact. Its mission is to assume the counter-offensive and crush the enemy when the right time

comes. To this rule of the use of the general reserve there is but one exception: absolute necessity of using it otherwise.

To sum up the means of defense against the different forms of attack:

Frontal attack is defeated by effective fire and counter-attack.

Enveloping movements are defeated by timely disposition of the reserves, by effective fire, and possibly by counter-attack directed against the weakest point of the attacking enemy.

Penetrating attacks are defeated by proper placing of the reserves, by fire and by counter-action.

Questions

Question 1. The Blue artillery has reached the position designated by the brigade commander. Place the batteries in their exact positions on the map. What will be the range of the Goat Hill group, provided it fires on the enemy battery at Ash Inn?

Question 2. Place Blue Infantry in position on the map at 1:00 P.M.

Question 3. What will the commander of the Blue advance guard order after having reached the edge of the forest?

Question 4. The Blue skirmish line appears at the short western edge of the Paoly Forest at 12:50 P.M. What will happen?

Question 5. What disposition will General G make in regard to the squadron after its arrival in Pottstown?

Question 6. Give an account of the rifle fire which followed the return of the Red squadron at 10:32 A.M.?

Question 7. The matter of making connections with the Red division north of Nehaminy river was omitted from General G's order. Is this an error?

* * * * * * * *

[The tenth War Game will deal with the entrenchment of the Blue forces and the work of trench warfare. This series began with the issue of March 11th, 1916. A large map, in colors, of the terrain covered by the series was published in the issue of March 25th. Copies of this map may be had for ten cents each.—EDITOR.]

NEW BOOKS, ETC.

WIRING HOUSES FOR THE ELECTRIC LIGHT. Together With Special References To Low Voltage Systems. By Norman H. Schneider. New York: Spon & Chamberlain, 1916. 12mo.; 112 pp.; illustrated.

The new edition of this handbook incorporates many of the improvements that are constantly being made in the field it covers. Among the new material may be noted a section on conduit and protected wiring and some additional full-page plates. Progressive instruction is furnished in planning the wiring, in completing the installation, and in installing the light fixtures. Concentric wiring, a system much in use abroad and well adapted to the less pretentious dwelling, is clearly explained, and the estimating of material is an important feature that has not been overlooked.

CHANGES IN THE FOOD SUPPLY AND THEIR RELATION TO NUTRITION. By Lafayette B. Mendel. New York: Yale University Press, 1916. 12mo.; 61 pp. Price, 50 cents net.

The preservative methods of to-day keep fresh fish in prime condition for two years, and allow us to draw upon China for our egg supply. This essay by a well-known physiological chemist is a thoughtful review of the situation in the light of history and statistics. It approaches the problem of the nutrition of the masses from a physiological standpoint, and takes up reforms in diet such as have been made necessary in Germany under the conditions of the war.

SUBMARINES. Their Mechanism and Operation. By Frederick A. Talbot. Philadelphia: J. B. Lippincott Company, 1915. 8vo.; 274 pp.; illustrated. Price, $1.25 net.

In his latest work, Mr. Talbot has done for the submarine what in his earlier volume, "Aeroplanes and Dirigibles," he did for aircraft; he has brought broad mechanical principles and tactical operation to the understanding of the general reader, without becoming at any time tedious or obscure. Of course, all the information conveyed is of a broad and somewhat superficial nature; to go deeply into the complex engineering and scientific problems involved would be to lose his audience; but all questions likely to arise in the mind of the average man are answered. There is a brief history of the under-water craft with particular reference to the Holland and Lake types, but by far the greater portion of the book is devoted to the first use of the submarine in war.

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Compressed Air

Its Production, Uses and Applications. By GARDNER D. HISCOX, M.E. 6½x9½. Cloth. 665 pages, 540 illustrations. Price, $5.00.

¶ This is the most complete book on the subject of compressed air and its applications that has ever been published, and covers almost every phase of the subject that one can think of. Taken as a whole it may be called an encyclopedia of compressed air. It is written by an expert, who has dealt with the subject in a comprehensive manner, no phase of it being omitted.

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4A

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Shave-consciousness and self-consciousness—

Both are bad business, and especially bad in business.

Most men are shave-conscious because the daily shave makes their faces burn, smart, fret and sulk.

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Ordinary roads become impassable under war traffic.

Photo by Brown Bros.

Courtesy Collier's Weekly

The kind of traffic roads must withstand in war. Austrian artillery on the march.

English truck mired in a flooded road.

Photo by Paul Thompson

Photo by Brown Bros.

Permanent roads are an absolute necessity for the proper transportation of war material.

Courtesy Collier's Weekly

This is the kind of road that saved Paris. Auto mitrailleuses ready to open fire.

Concrete Roads Will Withstand the Traffic of Peace or War

NEVER before have roads played a greater part in the world's history. The present war teaches not only the enormous importance of permanent roads as a measure of preparedness, but illustrates with startling vividness the necessity of permanent highways to meet the demands of modern motor traffic.

War demands roads that will successfully withstand the concentrated traffic of thousands of motor vehicles, heavy trucks loaded with men, supplies and ammunition, great guns often weighing many tons and swift cars for rapid transportation in great emergencies. The normal traffic of twenty years is often duplicated in a few weeks, and the roads must withstand it.

An editorial in Harper's Weekly, February 12, 1916, says: "Once the automobile was a luxury. Today we all know vaguely the immense rôle it plays. The war has been reminding us of one side of it, for there it has had a leading rôle. It saved Paris and it has changed the whole nature of warfare."

But the requirements of peaceful traffic are no less surprising. Not only has military transportation completely changed, but the highway traffic of the United States has in a few years undergone radical transformation. The editorial continues:

"We see the horse disappearing from cities; we see the delivery wagons of great stores; we see a serious volume of express business being done by automobile; we see farming and the lives of farmers being changed. . . . Think what it means that sixty-five per cent of American cars purchased last year were delivered through towns of 5,000 or less."

Macadam roads, once sufficient for the requirements of horse-drawn traffic, cannot resist the motor traffic of peace, much less that of war. The passage of heavy trucks and the shearing action of the tires of swiftly moving pleasure cars soon tear loose the surface of the best macadam and leave a road raveled, rutted and unfit for traffic. Of all *permanent* roads concrete alone offers at the lowest first cost and at the lowest maintenance cost the road that can successfully withstand the changing traffic of today.

Edwin A. Stevens, Commissioner of Public Roads, New Jersey, in an article in the February Scribner's entitled "The Future of Good Roads in State and Nation," says:

"The military features of our roads have been all but entirely overlooked. Strategically, roads must connect points of military importance. Tactically, they must be designed to carry necessary military traffic. In the light of the experience of the great war, this means that very heavy loads, guns of 6 and 8 inch calibre, heavy motor-trucks, high-speed cars, cavalry and infantry must be accommodated."

Our illustrated booklet **"Concrete Facts About Concrete Roads"** will be sent free of charge on request. We invite correspondence relative to concrete road construction and maintenance.

That sixty-five per cent of automobiles made in 1915 were sold in rural communities illustrates the immediate necessity for roads that will withstand the demands of modern traffic. That farmers in nine states alone owned on January 1, 1915, $250,000,000 worth of cars proves that the automobile has made permanent roads a vital issue.

A concrete road of 16 feet wide costs on an average $15,000 a mile to build and less than $50 a year to maintain. The first cost is but little more than macadam; the maintenance infinitely less. Furthermore, the concrete road will actually grow stronger with age, while the average macadam road must be entirely rebuilt approximately every seven years.

The average cost of different types of roads are given in the 1915 New York State Highway report by Edwin Duffey, Commissioner of the Highway Department, as follows: "It may be said here that the experience of the Department shows—all conditions of course included—that the average cost of the water-bound macadam road has been about $10,000 a mile. The average cost of a bituminous road, penetration method, has been about $13,000 a mile. The average cost of a first-class concrete road has been about $15,000 a mile, and the average cost of brick pavements has been about $25,000 a mile. These figures include engineering and inspection."

Figures compiled from the New York State Highway reports of 1913 and 1914 show the average cost of 38.7 miles of oil macadam as $11,780 per mile and an annual maintenance cost of $933 per mile. The average cost of 71.96 miles of bituminous macadam was $12,830 per mile and the maintenance cost $605 per mile per year.

Compare the above figures with those given in the 1915 report of the County Highway Commission of Milwaukee County, Wisconsin, which shows the maintenance cost of 86 miles of concrete roads as only $58 per mile per year. Of this small sum approximately $23 per mile was spent for the maintenance of the road shoulders, etc., leaving the maintenance on the concrete only $35 per mile.

The above figures point to but one conclusion—that permanent concrete roads with their low maintenance cost give the most economical results.

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